A Mini Project Report on

Human Activity Recognition

T.E. - I.T Engineering

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CERTIFICATE

This to certify that the Mini Project report on **Human Activity Recognition** has been submitted by Rohan Bait (21204008), Pratik Pandit (21204009) and Pratham Pise (20104069) who are a Bonafede students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfilment of the requirement for the degree in **Information Technology**, during the academic year **2022-2023** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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ABSTRACT

Human pose estimation is an important research area in computer vision and robotics that aims to accurately detect and track human body joints and pose in real-time from images or videos. The objective of this project is to develop a robust human pose estimation system that can accurately estimate the pose of humans in different environments and scenarios. The proposed system employs machine learning algorithms such as deep learning and tensorflow model to extract features from the image data and estimate the 3D coordinates of the human body joints. The system is evaluated using various datasets and metrics, and the results demonstrate its effectiveness and accuracy in estimating human poses. The proposed system has potential applications in a wide range of fields, including healthcare, sports, entertainment, and robotics, where the accurate estimation of human poses can provide valuable insights into the behavior of individuals and enable the development of intelligent systems.

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Chapter 1

1. Introduction

Human activity recognition (HAR) is the process of automatically identifying and classifying human activities from sensor such as video data. The HAR is to create systems that can accurately recognize activities such as walking, running, sitting, standing, and other activities of daily living. The ultimate goal of HAR is to accurately recognize activities in various contexts and improve quality of life for individuals in different fields. The current scenario of pandemics and lockdown made people staying in home for long periods of time, but this cannot be a relevant excuse for being unproductive because it is an excellent idea to utilize the extra time we get for our own health. The main motivation behind this project is to make exercise easier and fun for people and make it more effective for them so that they can exercise more effectively in their own homes.

1.1 Purpose

The purpose of human pose estimation is to accurately determine the position and orientation of a person's body in an image or video. This technology has many practical applications, such as:

1) Human-Computer Interaction: Pose estimation can be used to create more natural and intuitive interfaces for human-computer interaction.
2) Robotics: Robots can use pose estimation to interact with humans more effectively.
3) Sports Analysis: Pose estimation can be used to analyze the movements of athletes to improve their performance.
4) Healthcare: Pose estimation can be used in healthcare to monitor the movements and postures of patients to assess their condition or to help with rehabilitation after an injury.

1.2 Problem Statement

The problem statement for human pose estimation is to accurately and efficiently determine the position and orientation of a person's body in an image or video, given the variability in body size, clothing, lighting conditions, and other factors that can affect the appearance of the person in the image. The challenge is to develop robust algorithms that can accurately detect and localize key points on the human body, such as joints and limbs, and use this information to estimate the overall pose. The problem also involves dealing with occlusions, where parts of the body may be hidden or obscured, and handling the large variability in body shapes and poses across different individuals and activities. The goal is to develop methods that can accurately estimate human pose in a wide range of real-world settings and applications, such as human-robot interaction, sports analysis, and healthcare, among others.

1.3 Objectives

1) Human activity recognition (HAR) aims to classify a person's actions from a series of measurements captured by sensors.
2) The primary goal of HAR is to create a system that can automatically recognize and classify activities such as walking, running, sitting, standing etc.
3) In general, the objective of HAR is to use machine learning and other AI techniques to automatically recognize and classify human activities, with the goal of improving efficiency, safety, and quality of life in various contexts.

1.4 Scope

HAR is a rapidly growing area of research, and its scope is expanding with advances in technology and new applications. It can be useful for people to learn yoga movements at home easily. It can also help to get a correct form of a certain yoga pose as it will track the movements of the person and once the pose is perfect it will inform. As u can learn yoga poses from home it will definitely save time and also avoid travelling to yoga centers. The gym pose estimation system can track the user's progress over time, including improvements in form, strength, and flexibility. This can help users set and achieve their fitness goals more effectively. The primary scope of a gym pose estimation project is to analyze the form of an individual performing an exercise. This can include detecting whether the exercise is being performed correctly or not, detecting the presence of common mistakes, and providing feedback to the user.

Chapter 2

2. Literature Review

Sr.no	Title	Author(s)	Year	Algorithms	Limitations	Result
1	A Deep Learning Framework for Human Pose Estimation in Gym Environments	Srinivasan, D.	2020	Convolutional Pose Machines (CPMs)	Only tested on single-person scenarios, limited to indoor environments with static cameras	Achieved state-of-the-art results on single-person pose estimation benchmarks
2	Pose2Pose: Pose Estimation for Action Transfer in the Gym	M. Pfeiffer, A. Dornbush, R. Berlich	2019	RetinaNet and Mask R-CNN	Limited to certain actions and environments, requires labeled action data	Improved the accuracy of action transfer from a source video to a target video in gym environments
3	3D Human Pose Estimation in the Wild by Adversarial Learning	S. Liu, L. Qi, H. Qin, J. Shi	2021	Adversarial learning approach	Limited by the quality of input images, may not generalize well to different camera viewpoints	Achieved state-of-the-art results on several challenging 3D pose estimation benchmarks

Chapter 3

2. Proposed System

Algorithm Used:

1) Posenet -

The PoseNet model used in Gym Pose Estimation is trained on a large dataset of images and videos of people in various poses and positions. During training, the model learns to recognize the patterns and relationships between the key body joints,which allows it to estimate the pose of a person in an image or video. To use PoseNet for pose estimation in Gym, the model is first initialized with pre-trained weights. Then, for each frame of a video or image, the model processes the input using its CNN architecture to generate a set of feature maps.

2) TensorFlow -

The TensorFlow model works by taking an input image or video frame and processing it through a series of convolutional layers. These layers are designed to extract relevant features from the image, such as the position of key body joints and other landmarks. The output of the convolutional layers is then passed through a series of fully connected layers, which are designed to map the input features to a set of 3D joint coordinates that represent the estimated pose of a person in the image or video.

Overall, the goal of a gym pose estimation project is to provide a comprehensive analysis of exercise performance to help users improve their form and achieve their fitness goals.

3.1 Features and Functionality

1) Real-time Tracking:

Pose estimation algorithms can track the movement of the body in real-time, allowing for applications such as motion tracking

2) Body Pose Estimation:

Using the joint positions and orientations, the algorithm can then estimate the overall pose of the body, including its orientation and posture.

3) Accuracy:

Determining pose accuracy in form of percentage

Chapter 4

4. Requirements Analysis

Feasibility Study -

Whenever a new system (hardware or software) is to be introduced, there is a need to study every aspect or manner before working on it. The four main consideration of the study are:

1) Time Feasibility: Time feasibility refers to the time management of the project. It refers to the time and process incurred during the development of the project.

2) Technical Feasibility: Technical feasibility refers to technical knowledge and auxiliary devices required. Since our project is in Visual Basic 6 so we need to have a strong base of this programming language. And programming language we have used is Python and Flask to integrate html and python as well as machine learning models like tensorflow , posenet etc.

3) Costing Feasibility: Costing Feasibility refers to the cost the project members have done toward the project since our project is tried to be made as economical as possible.

4) Economical Feasibility: the hardware/software setup required is that the proposed system can be easily run on any dual core smartphone and as the software used to build system is Visual Studio code in windows 11 or we can build this in Linux also. So it does not cost high.

5) Operational Feasibility: Operational feasibility means it is possible to practically implement the project. While installing this software, the hardware, and software. One of the objectives of developing and user friendly application apart from speeding of the operation is that users do not face any problem while performing any kind of exercises.

Chapter 5

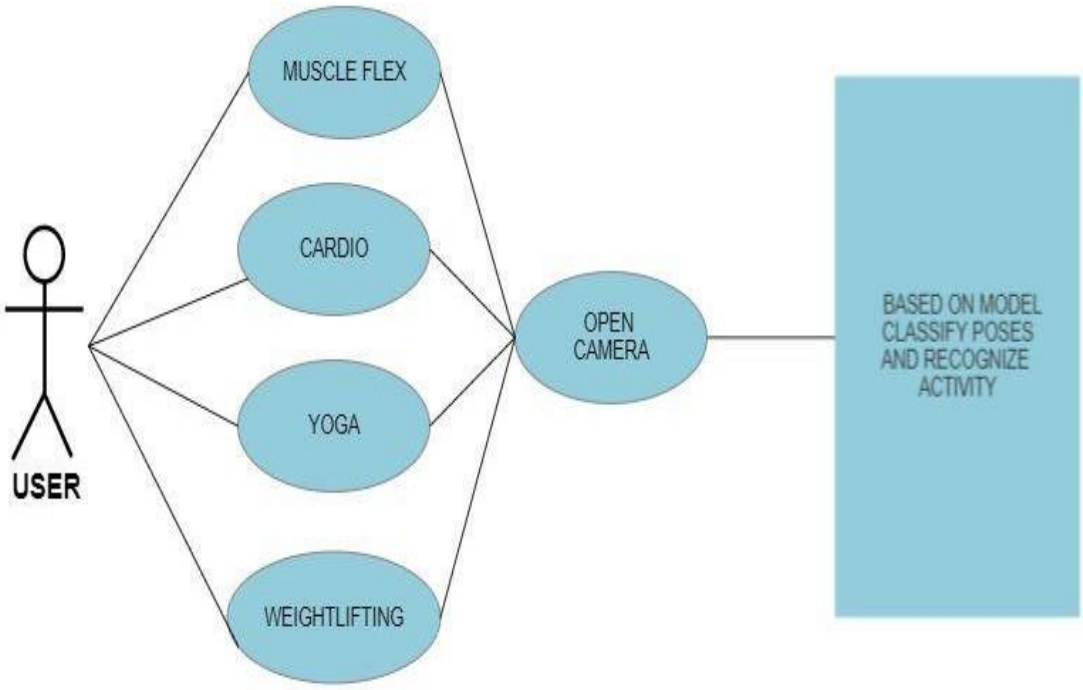
5. Project Design

In this phase, a logical system is built which fulfills the given requirements. Design phase of software development deals with transforming the client's requirements into a logically working system.

5.1 Use Case Diagram :

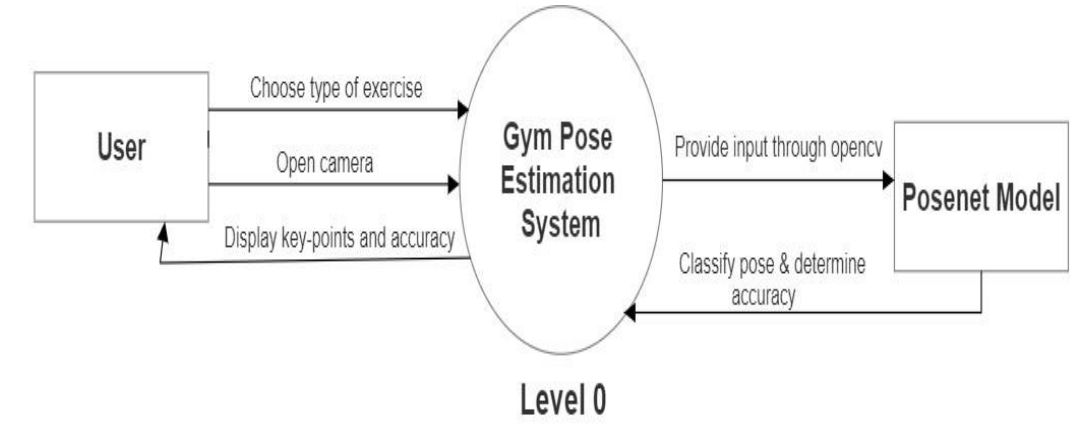
In the Unified Modeling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system.To build one, you'll use a set of specialized symbols and connectors.

Gym Pose Estimation System



5.2 DFD (Data Flow Diagram) :

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled. They can be used to analyze an existing system or model a new one.



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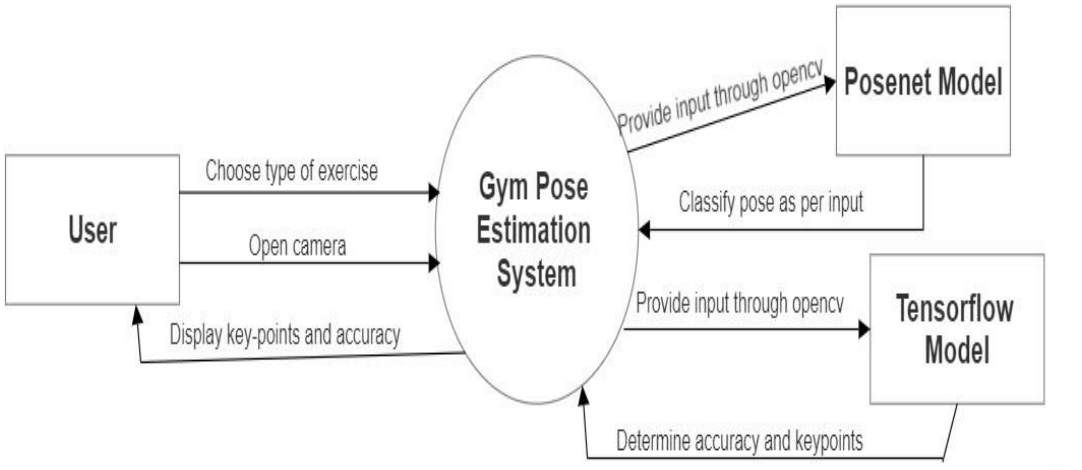
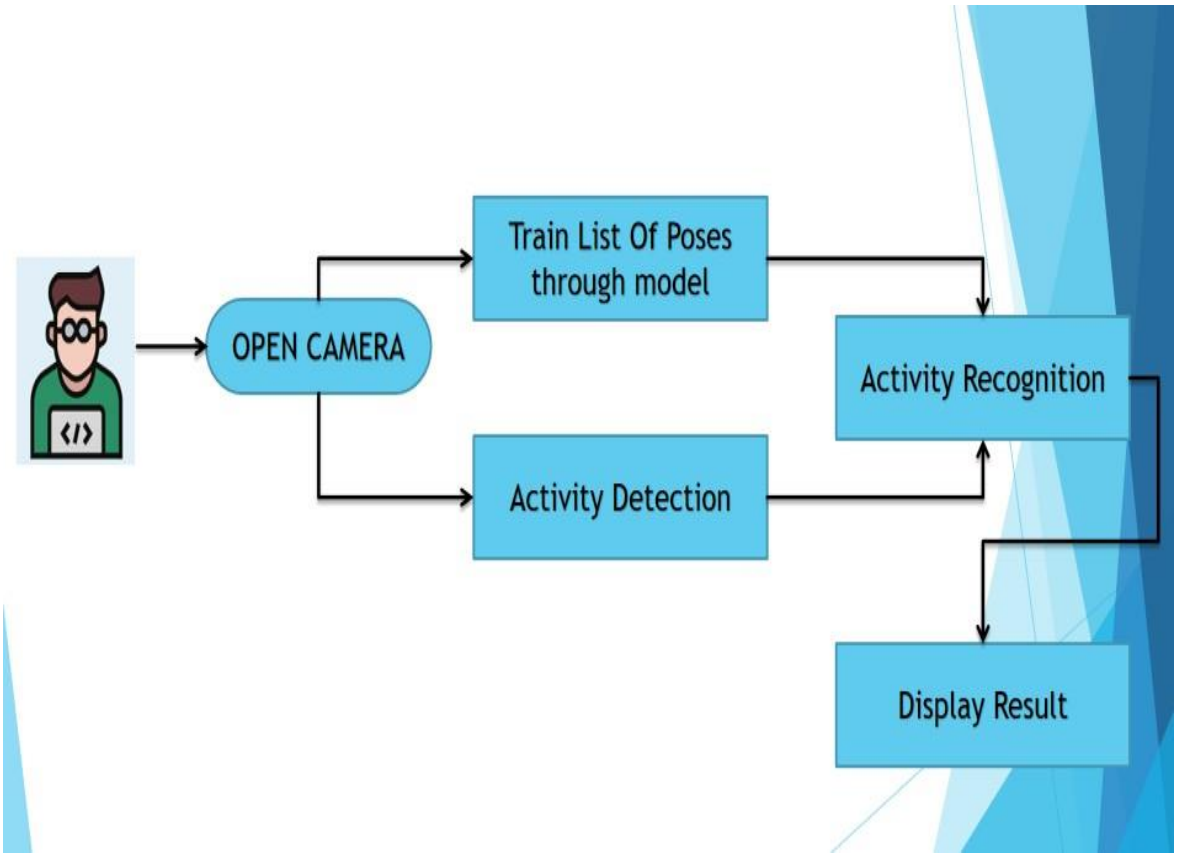


Level 1

5.3 System Architecture :

When user logins to the application the user just has to enter choose any category of gym exercises. By selecting any one exercise the camera will start and visualize live human poses and this data will be inputted to posenet algorithm which will classify the pose and the TensorFlow model will determine accuracy and key points based on input.



Chapter 6

6. Technical Specification

Hardware Required :

1) Standard computer with at least i3 processor Standard computer with 4GB of RAM

2) Standard computer with 100GB of free space

3) Active Internet Connectivity with good bandwidth

Software Required :

1) HTML , CSS , JavaScript - For Frontend

2) Visual Studio / Sublime Text

3) Python - For Backend

4) Flask to integrate frontend & backend

5) Python libraries like Tensorflow , Posenet , Mediapipe, Keras

Operating System :

Windows 10 / 11

Chapter 7

7. Project Scheduling :

Sr. No	Group Member	Time duration	Work to be done
1	Pratik Pandit	1st week of January	Implementing GUI and connecting camera accessibility/Designing a user friendly interface which displays web pages of gym web application and establishing browser camera connection.
		2nd week of January	Testing GUI and Camera/ checking proper routing and interactions of web pages in application and testing opencv accessibility.
2	Rohan Bait	3rd week of January	Implementing Posenet Model / adding a pose datasets and classifying poses according to camera visuals
3	Pratham Pise	By the end of march month	Implementing TensorFlow Model/ showcasing accuracy of poses and key-points with percentage.

Chapter 8

8. Implementation

app.py > ...

```python
from flask import Flask, render_template
from subprocess import call

app = Flask(__name__, static_folder='static', template_folder='templates')

@app.route('/')
def index():
    return render_template('index.html')

@app.route('/contact')
def contact():
    return render_template('contact.html')

@app.route('/products')
def products():
    return render_template('products.html')

@app.route('/about')
def about():
    return render_template('about.html')

#----------------cardio---------------->

@app.route('/cardio_details')
def cardio_details():
    return render_template('cardio_details.html')

@app.route('/cardio_details1')
def cardio_details1():
    return render_template('cardio_details1.html')

@app.route('/cardio_details2')
def cardio_details2():
    return render_template('cardio_details2.html')

@app.route('/cardio_details3')
def cardio_details3():
```

PoseModule.py > ...

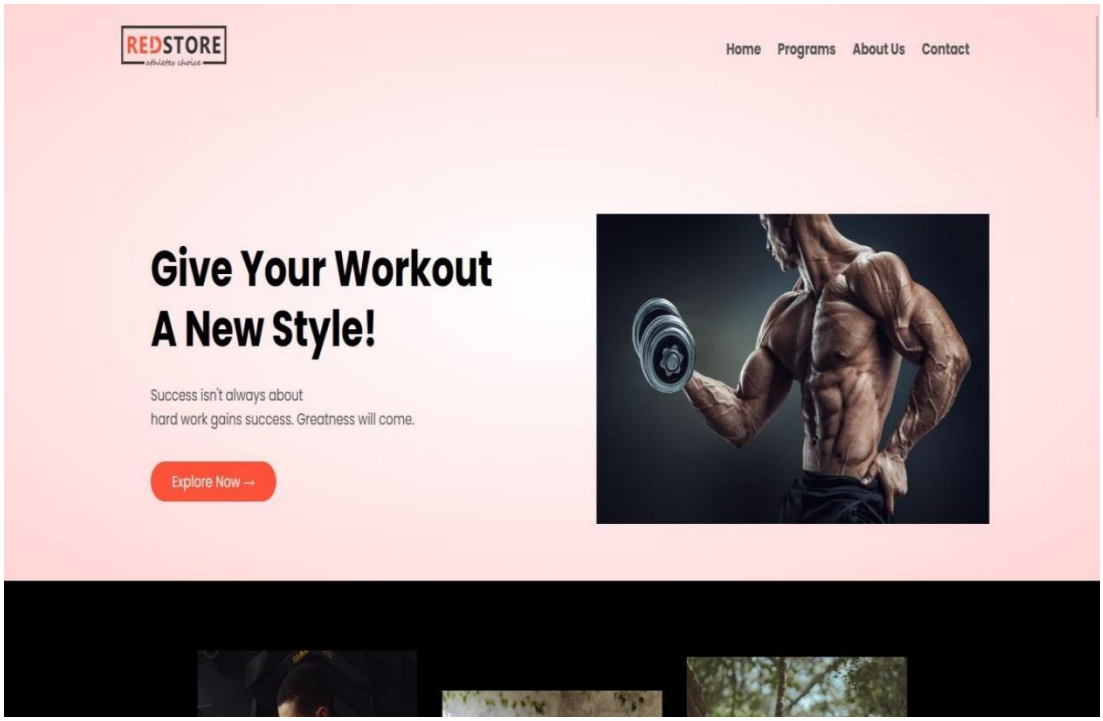
```python
import math

import cv2 as cv
import mediapipe as mp


class PoseDetector:

    def __init__(self, mode=False, upBody=False, smooth=True, detectionCon=0.5, trackCon=0.5):
        self.mode = mode
        self.upBody = upBody
        self.smooth = smooth
        self.detectionCon = detectionCon
        self.trackCon = trackCon
        self.mpPose = mp.solutions.pose
        self.mpDraw = mp.solutions.drawing_utils
        self.pose = self.mpPose.Pose(self.mode, self.upBody, self.smooth, self.detectionCon, self.trackCon)

    def get_pose(self, img, draw=True):
        # if not realtime
        # imgRGB = cv.cvtColor(img, cv.COLOR_BGR2RGB)
        # self.results = self.pose.process(imgRGB)

        #if realtime
        self.results = self.pose.process(img)

        if self.results.pose_landmarks:
            if draw:
                self.mpDraw.draw_landmarks(img, self.results.pose_landmarks, self.mpPose.POSE_CONNECTIONS)

        return img

    def get_position(self, img, draw=True):
        self.lmList = []
        if self.results.pose_landmarks:
            for id, lm in enumerate(self.results.pose_landmarks.landmark):
```

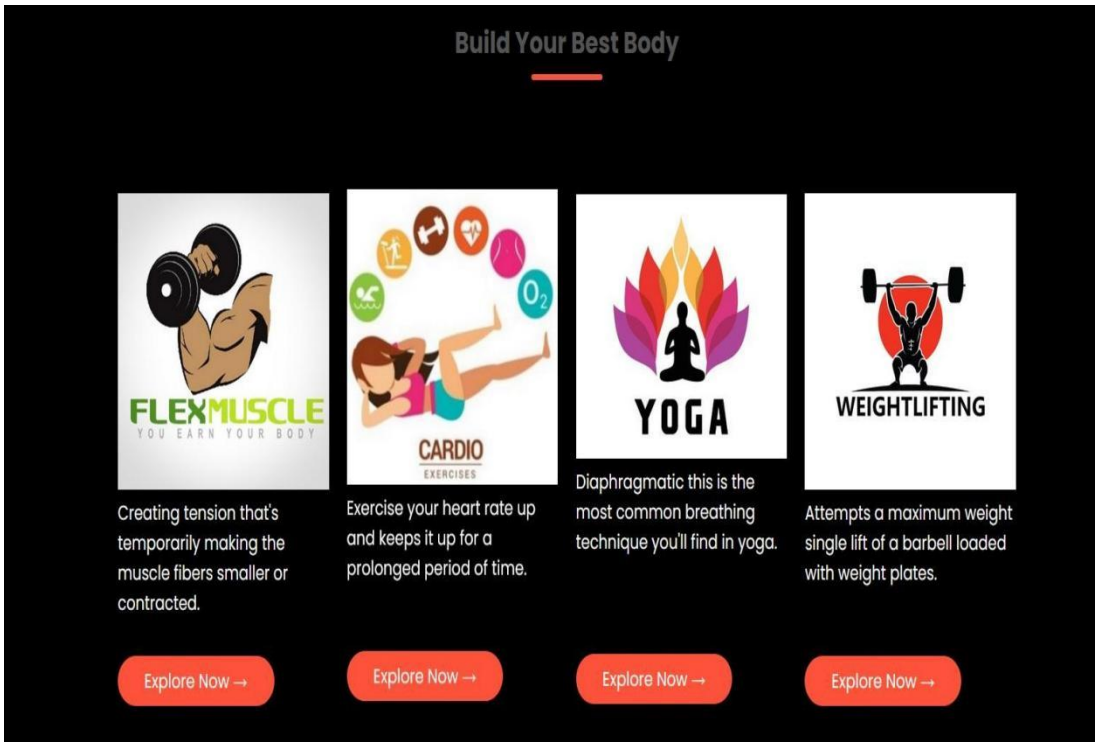
AITrainerProject.py > ...

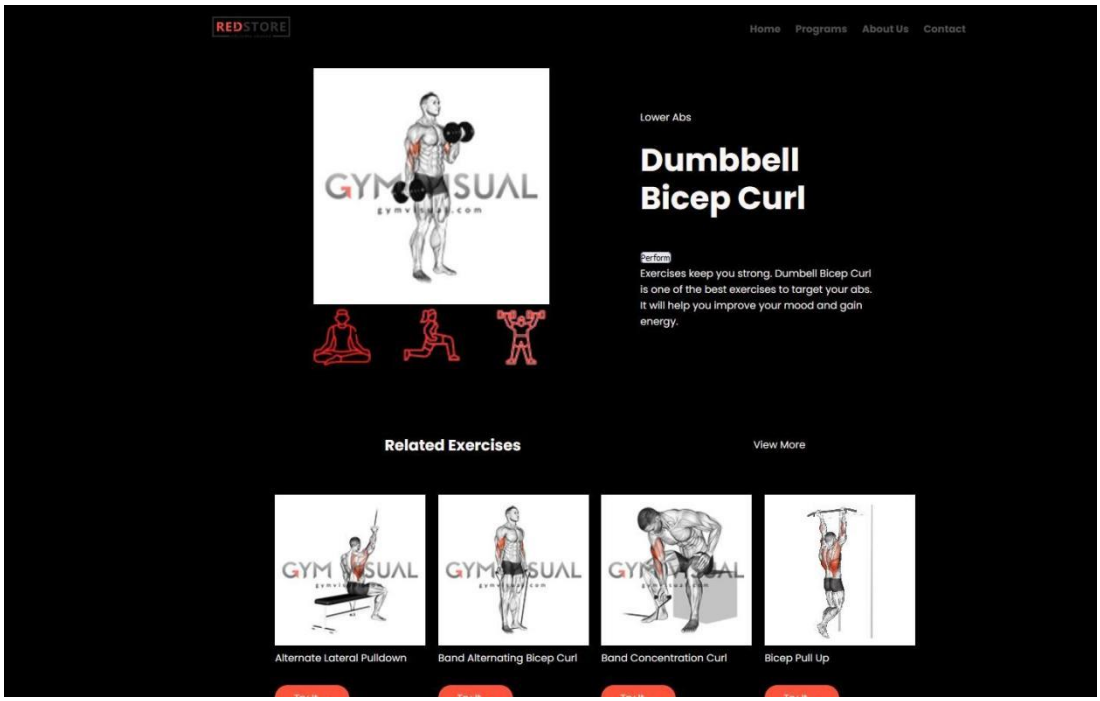
```python
import time

import cv2 as cv
import numpy as np
import PoseModule as pm

import tkinter as tk
from tkinter import ttk

# choose workout
def click(x):
    global flag
    win.destroy()
    flag = x


win = tk.Tk()
win.title("AI Trainer")
Lbl = ttk.Label(win, text="Choose your workout")
Lbl.pack()
flag = ""

action1 = ttk.Button(win, text="Bicep Curl", command=lambda: click("Bicep Curl"))
action2 = ttk.Button(win, text="Squat", command=lambda: click("Squat"))
action1.pack()
action2.pack()

win.mainloop()


def detect_bicep_curls():
    global per, bar
    # left arm
    angle = detector.get_angle(img, 11, 13, 15, draw=True)
    # right arm
    detector.get_angle(img, 12, 14, 16, draw=True)
    per = np.interp(angle, (50, 160), (100, 0))
```

Chapter 9

9. Result and Discussion



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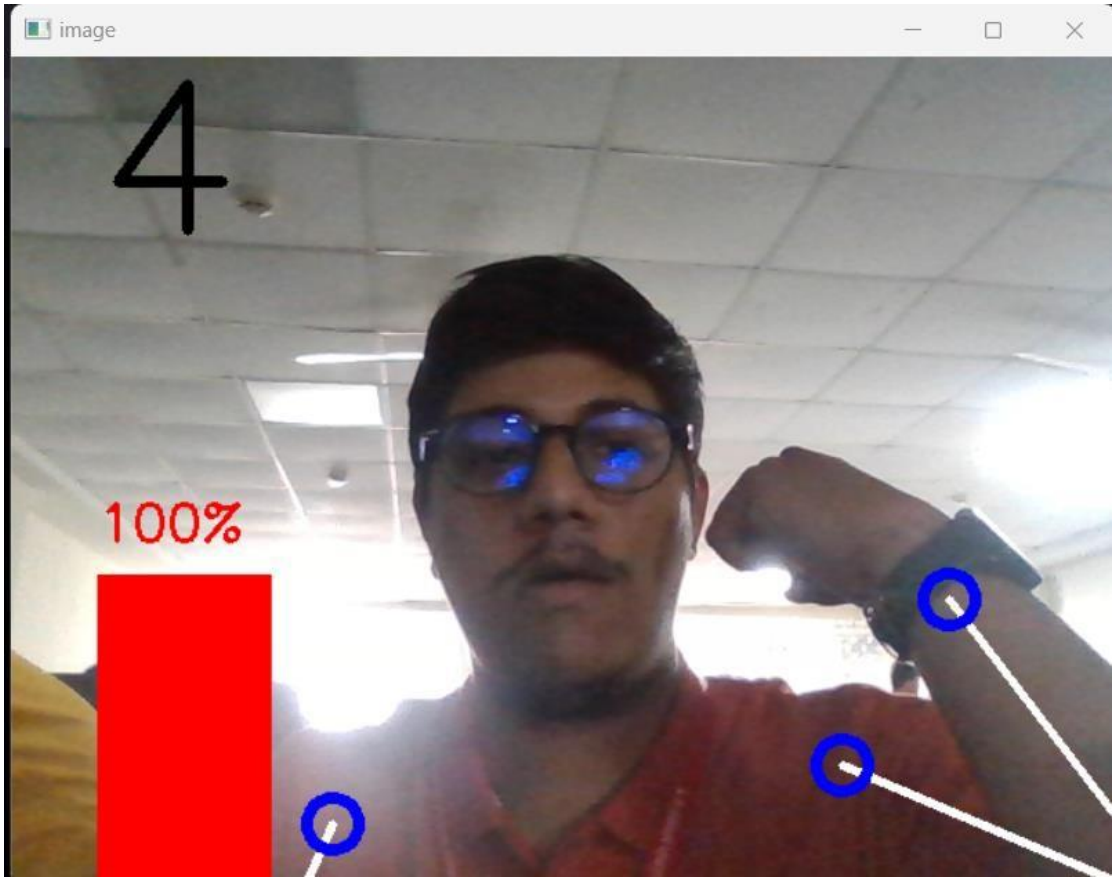
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Chapter 10

10. Conclusion and Future Scope

Gym pose estimation project can be a challenging but rewarding task. With the use of computer vision and machine learning techniques, it is possible to accurately estimate the poses of individuals performing exercises in a gym environment. One of the key advantages of this technology is that it can provide valuable insights for gym-goers and trainers alike. For example, it can help individuals ensure that they are performing exercises with the correct form, reducing the risk of injury and improving their overall results. It can also help trainers monitor their clients and provide feedback in real-time, improving the effectiveness of their training sessions. In conclusion, gym pose estimation is a promising field that has the potential to revolutionize the way we exercise and train. With further advancements in technology and continued research, we can expect to see even more accurate and reliable results in the future.

The future scope for gym pose estimation project is vast and promising. Here are some potential areas for further research and development:

1) Real-time feedback and coaching: With the use of AI-powered gym pose estimation, it may be possible to provide real-time feedback and coaching to gym-goers.
2) Multi-person tracking: Current gym pose estimation systems typically focus on a single person at a time. In the future, it may be possible to track multiple individuals simultaneously, allowing trainers to monitor entire classes or groups of gym-goers.
3) Integration with wearable technology: As wearable technology becomes more prevalent, it may be possible to integrate it with gym pose estimation systems.
4) Gamification: Gym pose estimation systems could be integrated with gaming technology to make workouts more engaging and enjoyable.

Overall, the future scope for gym pose estimation project is exciting, with the potential to transform the fitness industry and help individuals achieve their fitness goals more effectively.

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