Team Name: Descendants of the Sun

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PROBLEM STATEMENT:

PROBLEM TWO - REWARD A USER'S ACTIVITY INTENSITY
Build a detection and scoring system so that SSG can reward a user's activity intensity with SSG Coins!

SOLUTION:

Summary

- The main objective of this project is to build a user interface that recommends fitness training videos handpicked by experienced fitness trainers that are classified under various categories depending on the user's profile and ensures that they have a highly effective experience keeping their fitness levels on track in a virtual environment without any hassle.

- The recommended timings for a daily basis workout is by default set by the app which can be adjusted within certain limits to ensure transparency and efficiency.

- The **system tracks the intensity of muscular movement in reps that gets recorded and accordingly rewards points if they cross a particular threshold value set based on the user profiles.**

- Our system tries to focus on impactful fitness activities like **weightlifting, dumbbells , sit-ups and squats** and various other activities. Very often the postures are observed to be followed incorrectly or rather performed with less fervor. It tries to establish one of the main features to **validate the user's video stream** with the help of various computer vision tools and pre-trained machine learning models.

- The main focus of our system is to create a user friendly environment that encourages fitness enthusiasts and beginners to have a productive experience.

Approach/Design Principles:

- Firstly, the app requires new users to subscribe to the product and once a known face is encoded when a user signs up, it is used to compare it with the frames captured by the camera before recording starts in order to validate the user's face. For users who have been working out consistently they also have the opportunity to check out the workout of the day and try it out which is not considered for evaluation and points, however to provide an enriching user experience.

- Initially, the color of outfit of the user is noted and existence of the same color in at least minimal proportions is checked in the workout video from time to time which is implemented by using OpenCV and RGB libraries and functions available in Python and feature extraction.

- **MediaPipe Pose** is used as an ML pipeline for invalidating any inaccuracy in postures that the machine is trained to classify.

- For physical activities such as squats, push-ups and pull-ups, the ML pipeline with the help of few APIs as a solution enables the system to keep track of the reps completed in a given time period.

- The videos recorded are subjected to a particular time limit as each type of exercise is classified initially and the user is instructed to practice the posture recommended.

- Once the score for a particular workout is generated, the data recorded in order to generate the score, gets automatically removed from the existing database.

- Finally, the score is computed by the system If the value is below a certain threshold, the exercise is considered correct, otherwise it warns based on certain hints which body parts were in incorrect posture.

- The system checks for any inaccuracies in the posture and accordingly allocates points for the user with appropriate messages to motivate the user constantly till they achieve a predefined goal. Users who practice the postures accurately and with respect to the number of reps are rewarded with points and motivating messages as well.

- The system enables users ranging from beginners to experts to have an equally wholesome experience that motivates them to effectively workout in a virtual environment with minimal human support.

Technology Components/Requirements:

- Flutter for App Development
- Firebase for App Deployment and Database System
- Python for ML Modeling
- Frameworks like TensorFlow, Pytorch and Keras
- Flask for ML backend connectivity
- MediaPipe and OpenCV for posture detection and classification and facial recognition
- Colab/Jupyter Notebook

Risks Management:

- In order to prevent cheating, the system validates the user's facial features and attire within a given time period.

- Although prolonged internet connectivity is necessary for video recordings, data inconsistencies in case of network issues are avoided with the help of **Firebase**.

- The system evaluates the motion postures detected which are highly prominent considering the fact that any kind of motion captured on the mobile device is of minimal consideration value. As a result the system ensures that the scores are unbiased.

- One of the major and most common risks that we might face is when the user and trainer have different body ratios. Moreover, the user's camera might be tilted (portrait mode) and the camera to person distance might be different depending on the user and trainer videos. The system overcomes this issue by utilizing affine transformations in the frames.

- One of the major risks is if a proper network connection is affordable by everyone across the country since even in the current time period, people struggle to access good

internet connectivity. The app is open to all groups of people who will receive personalized recommendations based on physical parameters and the user profile.

- Another major issue that the system is subjected to is low model accuracy. This can occur due to various reasons such as the dataset, train-test split ratio and loss function. However, our aim is to achieve the best accuracy value of the model by modifying various essential parameters.

Phase-2 Prospects:

The system uses OpenCV for optical flow tracking which provides a highly efficient methodology to track motion of objects. As a result, on-device estimation of intermediate key-points as in body parts can be performed. Moreover, optical flow enables us to perform forward and backward tracking to handle errors in estimation.

Since the workout video is available offline, for each frame in the video we can run the pose estimation model to extract all body parts as a pre-processing step. This metadata can now be transferred to the local user device (mobile) for performing on-device analysis. For a real-time system we cannot run CNN on each frame to obtain body parts for the user video as it is time consuming and inefficient.

Workout videos with extracted metadata are sent to the user's mobile device. Followed by which a user performs and records the workout suggested and the body parts are extracted for every user frame.

Incorrect postures are detected accurately to ensure an unbiased system is followed while scoring users who have subscribed. Therefore, any means of cheating is effectively handled by the trained system and no points are awarded, in addition to inaccuracies detected in the recording.