Project Plan

PostureFit

Intelligent Fitness Trainer and Body Positioning App

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1. Project Background

The normal population in today’s world enjoys strength training (body or external weights) in their leisure time, no matter what their age group is or where they are - at home or in the gym. People usually get going by watching a series of how-to videos on YouTube, reading online tutorials, or even being coached by their local gym’s personal trainer. This is what the situation is like so far.

The option of performing self-training through videos or online text is not a very accurate method and is time-consuming – it is simply limited by the person’s perspective of understanding the exercise movement concept, especially in novices. This is also, unfortunately, where most people encounter injuries from improper repetitive form/posture [1], which may lead to chronic injuries. They may also not be aware of any possible underlying issues that may be causing their pain e.g., mobility issues, which often require a 3rd party to assist in identifying the cause [2]. The obvious solution to this would be to hire a personal trainer to observe you. This is where the economic factor comes in – the rate they charge you per hour is expensive [3]. This is where we believe PostureFit would fit into and help solve a range of problems in strength training, while creating a simpler and safer environment for users to enjoy while working out. Exercising should be fun, simple, and painless (including your pockets).

We are aware that there are similar products available in the market today such as IncludeHealth, which works by observing movements of body parts with a repetition counter as guidance during training [4]. This, however, does not include the functionality of correcting the movement form of the user, whereas PostureFit would observe, assess, and correct the user’s form, alongside other potential features. IncludeHealth is also yet to be available to the public.

2. Project Objective

Good fitness exercise relies on good form/posture to be effective and prevent unwanted injuries. This project aims to do the following as its main objectives:

2.1 Create a fitness application with an integrated feedback system

Today, there hardly exists fitness applications that guide users through their workout without needing them to guess which form/posture is proper or needs correction – they simply are one-way tutorials and do not offer recommendations/suggestions. Similar products present in the market usually require additional hardware that the user needs to purchase.

2.2 Create a cheaper alternative to conventional solutions

Hiring a coach would be a pricey solution to the problems associated with exercise. It is simply an option not everyone would find practical, especially in financial terms. The existing solutions available in today’s markets to this issue are also notorious for their pricing. An obvious one would be the costs associated with subscriptions to their application service which is not flexible to users’ needs – they charge users for the options they do not want. Plus, it gets more expensive with additional features, which often are just gimmicks. PostureFit aims to
solve this by providing what the users only need, paving the way to a ‘pay-as-you-need’ system. PostureFit is also aiming to provide users with functionalities that we believe users would find useful – innovating while reducing the complexity of the system.

2.3 Create a simple yet accurate recommendation system for form/posture analysis

We aim to develop a simple and effective recommendation system for form analysis that is user-friendly and intuitive, made for home and gym environments. PostureFit would observe and analyze the video/image, then provide suggestions with the help of lines, arrows, and colors to improve the user’s movement form. Having a proper form while exercising is crucial for preventing injuries and shall aid in the overall fitness success of the user.

This project aims to detect 1-2 types of movements as a test of concept. The application will be developed on iOS for iPhone 12 and up.

If time is sufficient, we may also execute the following objectives:

1. The application counts the repetitions and sets of the exercise performed by the user
2. The application detects the exercise the user is trying to perform

3. Project Methodology

3.1 Data Collection

We will collect videos of subjects doing 1-2 selected exercise movements (both at home and in-gym environments) for this project. We propose collection by one/combination of the following options:

1. Collection of videos from online sources/databases
2. Taking videos of ourselves/participants performing selected movements
3. Asking participants to submit videos of them performing the movements

The data shall then be classified as correct/incorrect with the guidance of an experienced physical education expert. The classification would be crucial as we intended to use it for supervised learning detailed in section 3.3.

3.2 Data Processing and Cleaning

Datapoints will be extracted from the video using a computer vision model called MoveNet. The model provides coordinates of 17 key body points including confidence levels and body point labels. We have decided on this model because the model has been trained with many fitness poses - thus, is compatible with the project goals. Missing data points can be calculated using the average of adjacent timeframes. Anomaly detection can also be used to detect incorrect data points.

3.3 Model Creation

We will explore multiple supervised learning algorithms to detect whether the movement is correct. Our first goal is to train our model to detect the correctness of the posture during key moments of each movement. We input still images of key moments extracted from the video with which different models would then be created to evaluate the correctness of the selected
moment. Additionally, we may explore the classification machine learning model to detect and differentiate between different types of movements.

3.4 Algorithm Creation

We will explore multiple regression models to find the variables needed to create a function that can determine the correct location of the key points as a function of time. We opted for the regression model because there exists a range of values that can be considered as proper form/posture; additionally, we are yet to know the function of the range. In accordance, we shall employ machine learning to help determine these values.

3.5 Application Development

The application we aim to develop will not require a server; data will be processed locally. The application would function as follows:

1. The camera would live-feed a series of images of the user’s movements
2. The live feed image frame would then be transformed into datapoints using Google TensorFlow’s MoveNet
3. The application shall display key points and green lines connecting them, for user feedback/reference
4. The data points would be fed into the model created from section 3.3, which would help identify when the user is starting the exercise
5. When the user starts from the first key point detected and has movement in accordance with the algorithm created in section 3.4, the application would display an overlay of proper form/posture, i.e., colors and lines
6. If the user’s dynamics do not follow that as calculated from the algorithm in section 3.4, the guidance line for the respective body part would turn red
## Project Schedule and Milestones

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<tr>
<th>Date</th>
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| 15 October 2022     | - Create wireframes/GUI for the application  
- First iOS Prototype: running MoveNet on iPhone, displaying real-time coordinates  
- Explore databases/collection some posture data (image/video) |
| 2 November 2022     | - Finalize data collection  
- Data wrangling (Processing, Transformation, and Cleaning) and EDA |
| 16 November 2022    | - First prototype machine learning model (detecting correct/incorrect movement)                                                          |
| 7 January 2023      | - Finalizes for the first presentation                                                                                                       |
| 21 January 2023     | - Second prototype machine learning model (Improve detection)  
- Deploy: Incorporate the prototype into the iOS application  
- Interim Report                                                                                                           |
| 15 February 2023    | - Create an algorithm to suggest posture correction                                                                                          |
| 1 March 2023        | - Deploy algorithm on iOS application                                                                                                          |
| 15 March 2023       | - Test application for real-world usage                                                                                                           |
| 5 April 2023        | - Final iOS deployment                                                                                                                         |
| 15 April 2023       | - Finalize report and presentation                                                                                                               |
References


