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Fitomatic: A Web Based Automated Healthcare Supervision and Monitoring App

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Abstract - *In recent times, people all around the world have realized the importance of maintaining a healthy lifestyle. Thus, more and more people have decided to focus on having a healthy and fit body. However, monitoring health and fitness without proper assistance could be confusing and difficult. To achieve a healthy and fit body, not only exercise but also a proper diet should be followed. Also, every individual has different fitness goals and thus, for every individual the fitness regimen differs. Keeping all these constraints in mind, we have proposed a system that helps beginners as well as fitness enthusiasts take the first step to achieve their fitness goals. Our solution aims to help individuals improve their quality of life, by recommending healthier diet and exercise plans by analyzing their BMI and monitoring the exercises done by the user. Since many individuals cannot make time out of their busy schedules to visit the gym, this system is beneficial to them because they can perform exercises and also get them monitored virtually without the need of a physical trainer.*

Key Words: **Machine Learning, MediaPipe, KNN, Fitness, Pose Detection, Recommendation, BMI**.

1.INTRODUCTION

In our work, we introduce Fitomatic, a web app which tracks the fitness activities of users, their diet and meal tracking, and detects the users exercise posture. Owing to busy schedules and work pressure people are not paying attention to their health and fitness. Physical inactiveness is the most important problem in today's generation. It is important to understand that diet and exercise varies from users having different lifestyles, height, weight, sex, age, and activity level, however diet and exercise are both correlated.

1.1 Importance of Fitness

The importance of having good physical fitness cannot be stressed any further in the times that we find ourselves right now. People have been struggling with various health-related problems [1] such as eye strain, mental stress, irregular sleep patterns, obesity, decreased immunity, etc. Immense emphasis has been put on by bodies like WHO (World Health Organization) since the spread of COVID-19 started increasing, on improving our health and immunity for being safe from the coronavirus and proper diet and exercise plays a pivotal role in making our bodies healthier. Some mobile applications provide expert support and sessions on a paid basis to get a more personalized and focused option for training and guidance. Thus, a product that is free of cost is needed so that it can be used by all.

1.2 Research Studies

Although people are becoming more and more health-conscious, they still do not have the time to dedicate to going to the gym. This explains why working people all around the world prefer health and fitness tracking apps. Recent Statistical studies show that within the first week of lockdown, the Daily Active Users (DAU) in Health & Fitness Apps category saw an upsurge of almost 14%. This led to a tremendously high download growth rate, nearly 157% was observed in-home fitness apps in India [2].

Therefore, a method is required which is much more accessible and at the same time, is reliable. In this work, we aim to:

- Provide a platform to satisfy all of users' needs at one place.
- Provide accurate and proper training, all at the convenience of users.
- Provide constant feedback to improve the quality of performance of users.
- Provide healthy diet plans which suit the user, taking into consideration their allergies and workout regimen.

2. RELATED WORK

A decent amount of work has been done for developing designs for health monitoring applications. In [3], a system is proposed which can help doctors to recommend diet and exercise to the patients. Deals with health monitoring of disease like diabetes etc. based on patients' latest reports using the Machine learning Technique i.e C4.5. They conclude C4.5 is better than the ID3 algorithm with respect to both the data-sets that were used.

S. Agarwal et al. [4], designed an application called FitMe, which aims to reduce the dependency on actual trainers and provide health benefits anywhere, anytime, free of cost and with limited hardware support. FitMe utilizes lightweight deep learning models for accurate pose estimation of the users. In addition to checking the accuracy of poses, it provides instant feedback to users so that they can maintain the right postures on the fly. The quality results obtained are shown in this work and further proved that it has massive scope for adoption by people for their fitness needs being inside their homes.

In [5] Gourangi Taware, Rohit Agrawal, Pratik Dhende , Prathamesh Jondhalekar, Shailesh Hule, introduce Fitcercise, an application that detects the exercise position of the user counts the prescribed exercise repetitions and gives individualized, comprehensive analysis about enhancing the user's body posture.

D. Shah, V. Rautela, C. Sharma and A. Florence A, "Yoga Pose Detection Using Posenet and k-NN [6] designed a project that carries a non-profit system that strives to develop core muscles using yoga-like poses. Virtual yoga asana practice is possible thanks to the totally accurate position detection provided by the proposed method. The cosine similarity technique is used to consider the deviation of the angle created with the original values. This study uses computer vision algorithms and the open pose to evaluate human poses and a person's yoga stance (open-source library). The proposed model was trained with 90% of data and tested with 10% of the same with real-time testing, resulting in 94 % accuracy.

A. Singh, S. Agarwal, P. Nagrath, A. Saxena and N. Thakur [7], an article that covers the problems with estimating human posture and provides an overview of extensive research on the subject, including deep learning methodology and conventional image-based algorithms, has been offered. The author has created a straightforward model using a convolutional neural network that estimates the postures and exemplifies the potential of CNNs after examining numerous findings and identifying the constraints.

An application is designed by Prof. Prajkta Khaire, Rishikesh Suvarna, Ashraf Chaudhary in [8], that provides the user with a complex algorithm which can provide the user with a diet plan based on his/her characteristics like height, weight, BMI. With just one button click, users will be able to register an account, manage their account, and access the diet through the suggested application's user-friendly User-Interface. It also offers the option to get in touch with a real nutritionist for advice if the user has a food allergy.

In another work presented by A. Henning, B. Alvarez, C. Brady, J. Kopec and E. Tkacz [9], have designed a Elasto-Trak that combines the cardiovascular workout of a treadmill with the resistance training of springs, thereby enabling users to achieve the benefits of both exercises simultaneously. The strength of the device's frame, the device's ability to successfully boost the user's heart rate into the cardiovascular training range, and the device's usability will all be tested.

Using a professional workout as a reference, Nagarkoti, R. Teotia, A. K. Mahale, and P. K. Das suggested a system in [10] to analyze a user's body position during exercise. In order to identify mistakes and offer the user corrective action, we depict the human body as a collection of limbs and examine angles between limb pairs.

Last but not least, S. Bian, V. F. Rey, P. Hevesi, and P. Lukowicz studied the potential of this sensory modality in gym workouts in [11], where they also detailed the physical theory underlying the pervasive electric coupling between the human body and surroundings.

2.1 Limitations

- Some mobile applications provide expert support and sessions on a paid basis to get a more personalized and focussed option for training and guidance.
- Tedious task of searching for integrity in the manual systems before.
- All existing systems are not well integrated. Rather they are good in their own respected work.
- Existing apps that used ML models for monitoring would only be able to estimate or identify the pose from a static image.
- Generation of the feedback in the form of paragraphs.
- Complex hardware infrastructure is neither affordable by users, nor is easy to use.

2.2 Problem Statement

Most users must utilize various applications to keep track of their workouts, routines, and diet preparation. Consumers eventually lose interest since they find it quite difficult to use several apps and maintain track of it. Although people are becoming more and more health-conscious, they still do not have the time to dedicate to going to the gym. This explains why working people all around the world prefer health and fitness tracking apps.

3. PROPOSED SYSTEM

3.1. System Design

To achieve the desired goal of recommending personalized diets along with exercise tracking, we use the following methodology, containing two phases; Phase 1: Diet recommendation and calorie tracking, Phase 2 : Exercise live monitoring and feedback generation.

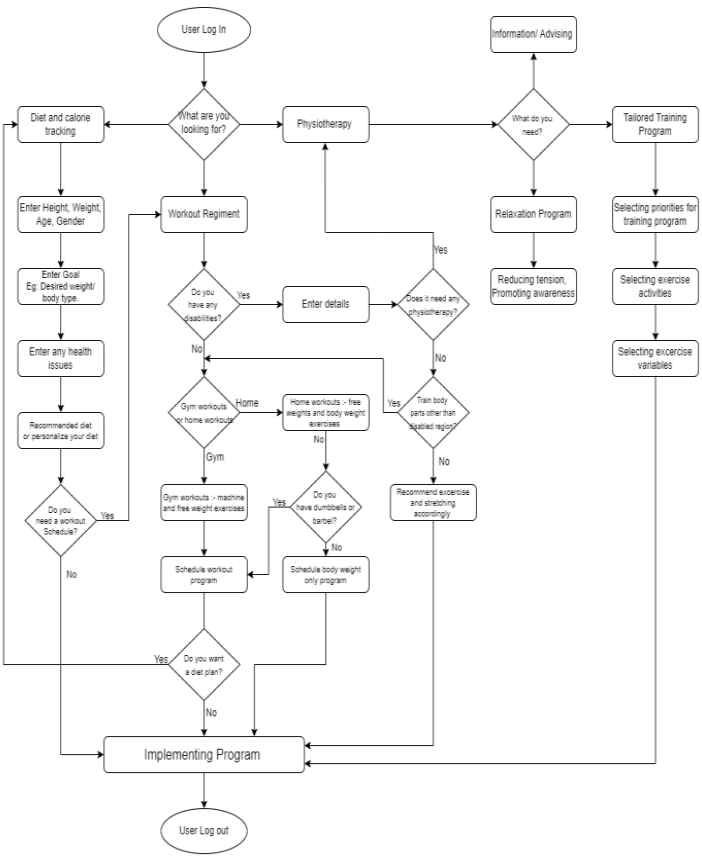

Fig-1: System Architecture

3.1.1. Diet Recommendation and Calorie Tracking

Diet recommendation is implemented using a content-based approach. A recommendation engine that bases its suggestions on an item's qualities or content is known as a content-based recommendation engine. It works by analyzing the content of items, such as text, images, or audio, and identifying patterns or features that are associated with certain items. The following step involves comparing goods and suggesting comparable ones to users using these patterns or attributes.

The procedure is as follows:

a) Taking user Data: Starting with entering patient's details such as height, weight, age, gender, activity level.

b) Calculating BMI: Calculation of BMI and calories required with formula using the personal details taken as input.

BMI (Body Mass Index) and Calories Requirement Calculation

BMI = [Body Weight (Kg)]/[Sq of body weight in m] =kg/m^2 Where, Underweight < 18.5

Normal Weight = 18.5 - 24.9

Overweight = 25 - 29.9

Obesity > 30 Calories:

For Men: 66.5 + 13.8(W) + 5.0(H) - 6.8(A)

For Women: 66.51 + 9.6(W) + 1.9(H) - 4.7(A)

Where, W = Weight in lbs. H = Height in inches. A = Age in years.

c) Content – based Filtering: The Recommendation engine uses information about the nutritional values and ingredients of foods to make personalized recommendations to users. Also, it takes into consideration an individual's dietary restrictions and preferences, such as allergies or food preferences.

d) Recommendation: Users are provided with a customized exclusive experience which will help them make better choices about what to eat and improve their overall health that is a diet is recommended.

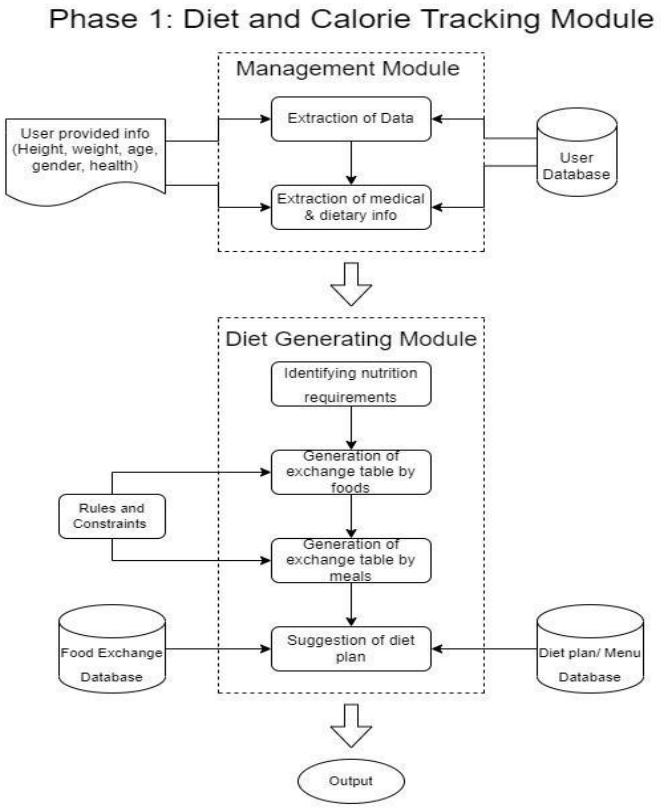

Fig -2: Diet Recommendation and Calorie Tracking

3.1.2. Exercise Recommendations and Pose Detection

Monitoring of user exercises is done by the method of pose estimation. Pose estimation refers to a computer vision technique that detects and tracks human figures or objects in videos and images. In the case of humans, it could help determine the location of the key body points.

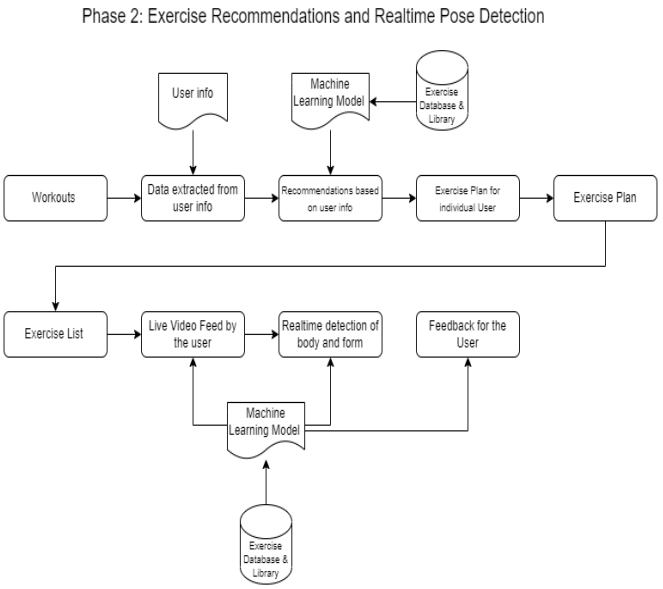

Fig -3: Exercise Monitoring and Pose Detection

3.2 Framework/Algorithm

3.2.1. Nearest Neighbor for Recommendation

The Nearest Neighbors model is utilized in the diet recommendation section for prediction, with the cosine metric being used for categorical data and the brute force technique being employed for a thorough search. The KNN model will curate a diet in accordance with the nutrient limit received from the user and advise it.

Based on their nutritional value, locate the foods or meals that are the closest to a specific food or meal.

Nearest neighbors can be used in a diet recommendation system to determine which foods are the most comparable in terms of nutrients. The concept is that if two foods have comparable nutrient profiles—for example, comparable levels of protein, fat, carbs, vitamins, and minerals—then they are probably going to have comparable impacts on the body in terms of nutrition and health.

In our project, we use a pre-trained KNeighborsClassifier on the data to unsupervised identify the samples that are most comparable.

The fig explains the deviation and distribution of the data points from a normal distribution and according to the test input, most similar samples from the dataset are recommended.

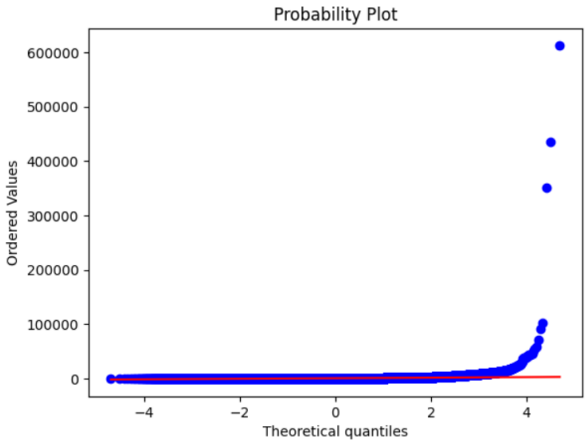

Chart-1: Probability plot of the dataset used

RecipeId	Name	Calories	FatContent	SaturatedFatContent	CholesterolContent
42	Cabbage Soup	103.6	0.4	0.1	0.0
308885	Sweet, Spicy and Flavorful Pizza Sauce	125.1	0.8	0.1	0.0
436612	Favorite No-Cook Pizza Sauce	102.9	0.6	0.1	0.0
400263	10 in 10 Diet Cabbage Soup	108.6	0.6	0.1	0.0
430060	Ange's Pizza Sauce	109.0	1.3	0.2	0.0

Fig -4: Results from Diet Recommendation System

3.2.2. Mediapipe holistic Framework

Mediapipe Holistic Framework enables live perception of simultaneous human pose, face landmarks, and hand tracking in real-time. It integrates separate models for pose, face and hand components, each of which are optimized for their particular domain. It is known to offer fast and accurate, yet separate, solutions for these tasks.

The steps to identify a success movement are:

a) Phone camera to capture a (or a series of) real-time images.

b) The python module then identifies the users' skeleton and joint position from the captured images.

c) When the skeleton and joint positions are pinned, the success of a movement is calculated.

d) If the movement is a success, the number counts. Once a set of work-out is done, the record is refreshed and kept for further advice. The fitness records that show one's improvement and achievements can be used for further advice.

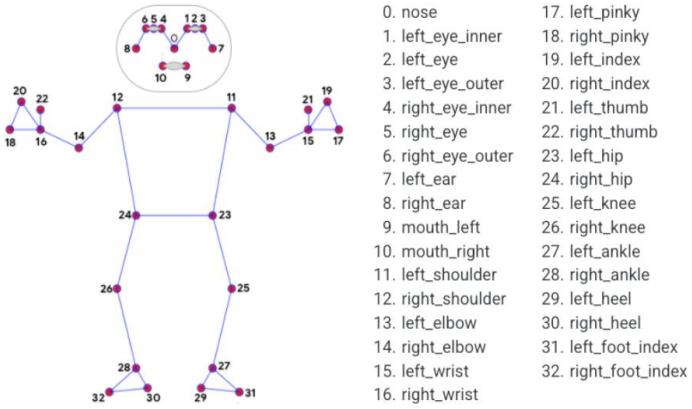

Fig -5: Body Pose Landmarks Detected by Mediapipe

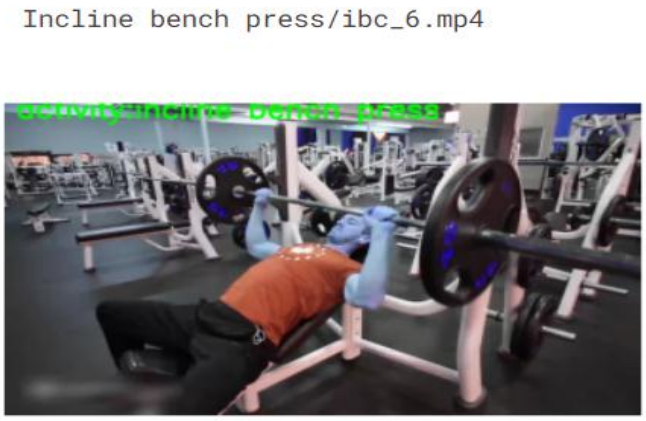

Fig -6: Recognition using Mediapipe

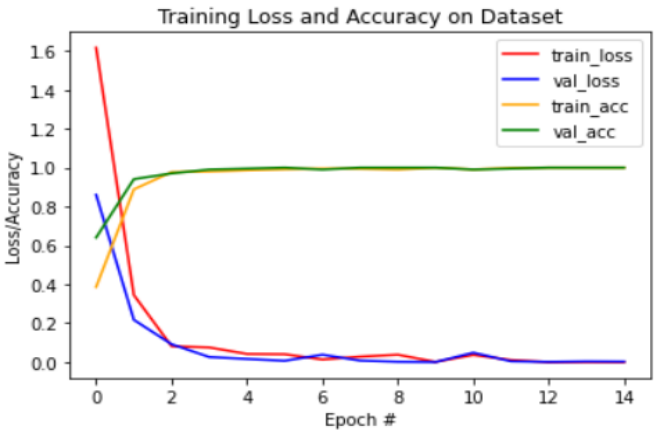

Chart -2: Training Loss and Accuracy

4. CONCLUSIONS

This work proposes an application designed specifically for fitness enthusiasts. By utilizing a web camera, machine learning modules and recommendation engines can help users achieve their fitness goals all at one place. The future work would consist of a system for tracking of diet and exercise and in continuation would provide alternate options with respect to the user's ailments to a particular food item or exercise in case of change of user preferences and creating a regular and emergency alert system to remind the user before every follow-up session and in alert user in cases of extreme reports.

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We wish to state that the work embodied in this project titled "Fitomatic: A Web Based Automated Healthcare Supervision and Monitoring App" forms our own contribution to the work carried out under the guidance of 'Prof. Dilip Dalgade's direction at MCT's Rajiv Gandhi Institute of Technology. We affirm that this written submission contains our ideas in our own words, and that when other people's thoughts or words are used, they are properly acknowledged and cited.

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