

AI Gym Buddy Using Mediapipe

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Abstract:- The AI Gym Trainer is a system that provides multiple features designed to provide personalized fitness coaching and nutrition tracking. Imposing the advanced pose estimation capabilities of Mediapipe, the system provides real-time responses to exercise performance, focusing on posture, alignment, and technique. This feature is helpful because users will receive accurate guidance in workout sessions, which in turn enhances effectiveness while minimizing the risk of injury. Furthermore, the AI Gym Trainer is implemented using machine learning algorithms, which makes it capable of providing tailor workout routines to individual preferences and abilities, encouraging a personalized training experience. Through a user-friendly interface accessible through a desktop or web application, users can seamlessly interact with the system, track their progress, and receive personalized recommendations. Additionally, the system has a feature of a Flask-based food tracking feature which enhances the capabilities, allowing users to monitor their calorie intake and receive nutritional analysis. This comprehensive approach addresses both physical activity and dietary habits, and provides users with a holistic platform for managing their fitness goals. Evaluation through rigorous testing and user trials demonstrates the effectiveness and potential impact of the AI Gym Trainer in promoting overall health and well-being. With its combination of cutting-edge technology and user-centric design, the AI Gym Trainer represents a significant advancement in personalized fitness coaching and nutrition tracking, catering to the diverse needs of individuals striving to achieve their fitness goals.

Keywords:- Artificial Intelligence(AI), Human Pose Estimation, Computer Vision, Machine Learning, Exercise, Diet.

I. INTRODUCTION

In the wake of technological advancements, virtually every industry, including fitness, has undergone significant transformation. Gone are the days when gyms and fitness clubs monopolized the provision of personal training services to help consumers achieve their fitness objectives.

Due to busy schedules, workload, people are not paying attention to their health and fitness. However, not everyone can afford to hire a gym trainer. That is when AI Gym trainers entered the scene. AI Gym trainers are revolutionizing fitness with their blend of digital programming and AI coaching. Those unfamiliar are sophisticated systems that use artificial intelligence to offer personalized workout routines, real-time feedback, and performance tracking, essentially functioning as virtual personal trainers. AI Gym trainers are artificial intelligence-powered virtual trainers who assist you in achieving your fitness goals. The computerized Gymtrainer may provide you with tailored training and diet regimens after gathering a few facts such as body measurements, current fitness level, fitness objectives, and more. Traditional gym training with personal trainers may not be feasible for everyone due to cost and time constraints. This is where AI Gym trainers' step in, revolutionizing fitness by offering personalized workout routines, real-time feedback, and performance tracking through sophisticated artificial intelligence. These virtual trainers are accessible anytime, anywhere, catering to individual needs and preferences regardless of fitness level. Leveraging advanced technologies such as machine learning and AI Gym trainers continuously optimizes coaching strategies based on user data, promoting long-term adherence and sustainable results.

II. PROBLEM STATEMENT & OBJECTIVES

During intense training, the body is subjected to a lot of stress and takes days or weeks to recover. During this "recovery phase," athletes need to rest parts of the body to allow muscles, tendons, and ligaments to heal. Teams that have a tough week of practice often underperform; Fatigue and injuries often keep some of the best teams in the game. Video processing consists of signal processing, which employs statistical analysis and video filters to extract information or perform video manipulation. Basic video processing techniques include trimming, image resizing, brightness and contrast adjustment, and fade in and fade out, amongst others. Many video processing methods, also known as computer vision technologies, rely on image recognition and data analysis to perform tasks such as facial recognition, some image detection, and human-computer interaction.

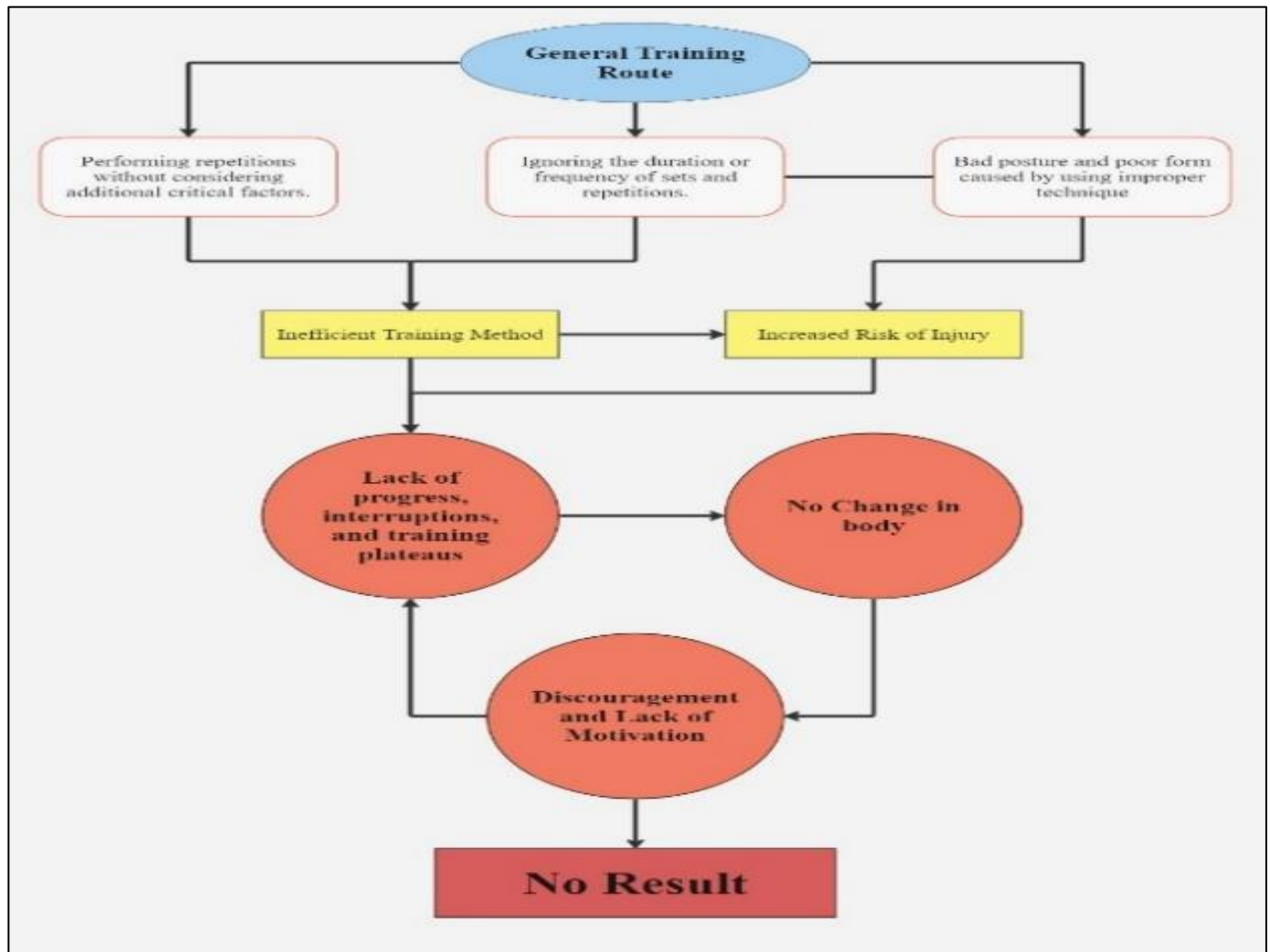


Fig 1: Problem Tree

III. LITERATURE REVIEW

We studied various papers based on the AI based fitness trainers and Diet planners, following are the papers which helped us in getting necessary insights for developing our project.

A. AI-Based Fitness Trainer:

In this paper, the author developed Fitcercise, a program that recognizes the user's exercise pose, tracks the number of repetitions of the prescribed exercise, and provides individualized, in-depth information about improving the user's body posture. This paper has the steps which depicted the development process of AI based fitness trainer. The first phase being the data gathering, cleaning and processing, while the next phase being development of an AI program that uses the data which has been customized to give an individual workout plan [2].

B. Smart Gym Trainer Using Human Pose Estimation:

This paper encompasses a fundamental problem in Human body pose estimation, which involves recovering the pose of articulated bodies from image-based observations. With the human body's complexity, including numerous degrees of freedom and variability, pose

estimation remains challenging. Algorithms must contend with variations in appearance, occlusions, and limited information from 2D images. Recent advancements, such as RGBD cameras, provide additional depth information. To develop a smart gym trainer using pose estimation, key steps include setting up a system for accurate estimation, comparing user workouts with expert demonstrations, and providing feedback for improvement, typically in the form of numerical angles and visual aids like graphs [1].

C. Fitness Trainer Application Using Artificial Intelligence:

The suggested method in this paper is detecting postures of the workout along with displaying repetitions count, set count also alerting the user with a beep sound for each set and also give information regarding how many calories are burnt during the workout and the proper dietary food plan is recommended. The proposed system in this paper consists of two modules one of which is dietary plan and the other one is Exercise Corrector and repetition counter. Dietary Plan is implemented using TDEE formula. The Exercise Corrector and repetition counter is implemented through mediapipe [6].

D. Fine-Fit: A Fine-grained Gym Exercises Recognition System:

In this paper, the Fine-Fit system tried to tackle the problem of detecting fine-grained gym exercises using a single source accelerometer. Fine-Fit includes a front-end acquisition hardware (wireless armband-shaped sensing network) and two main back-end processing modules (data preprocessing module and exercise recognition modeling module). The model proposed in this paper for exercise recognition is MREC (MUSCLE RECRUITMENT ENERGY COEFFICIENT) the algorithm used is random forest due to its high precision [3].

IV. PROPOSED SYSTEM

In order to track, analyze and correct the exercises along with keeping a track of nutrition we have developed a mediapipe and flask-based application along with a Graphical User Interface. The proposed framework will incorporate the following highlights:

- A Graphical User Interface which presents various exercises types to choose from according to user’s need and an additional option to open diet planner.
- The exercise analysis and tracking is done using human pose estimation to help users in tracking the exercise.
- The diet planner is Flask-based web application wherein users can keep record, get nutritional values of meals and check history of meals.

The GUI enlists the following exercises: Squats, Shoulder press, Curls, and Jumping Jacks. The Diet Planner can be used to get information about the breakfast, lunch, & dinner by entering the name of the food along with that we can get detailed information about the calories, proteins and carbohydrate contains about the food entered.

V. METHODOLOGY

To develop this application, we have leveraged the MediaPipe’s human pose estimation pipeline utilizes machine learning models, often based on convolutional neural networks (CNNs) or similar architectures, to detect and estimate key points on the human body in real-time. The Pose Estimation generates graphical representations of human skeletons. These skeletons serve as a visual roadmap of a person’s posture and movements, providing valuable insights into their activities. At the core of human pose estimation are key points or pose landmarks, which represent individual coordinates corresponding to specific joints in the body. These key points are essential for accurately depicting the pose of a person and tracking their movements over time. Moreover, the connections between these key points, referred to as pairs, further enhance the understanding of human motion dynamics.

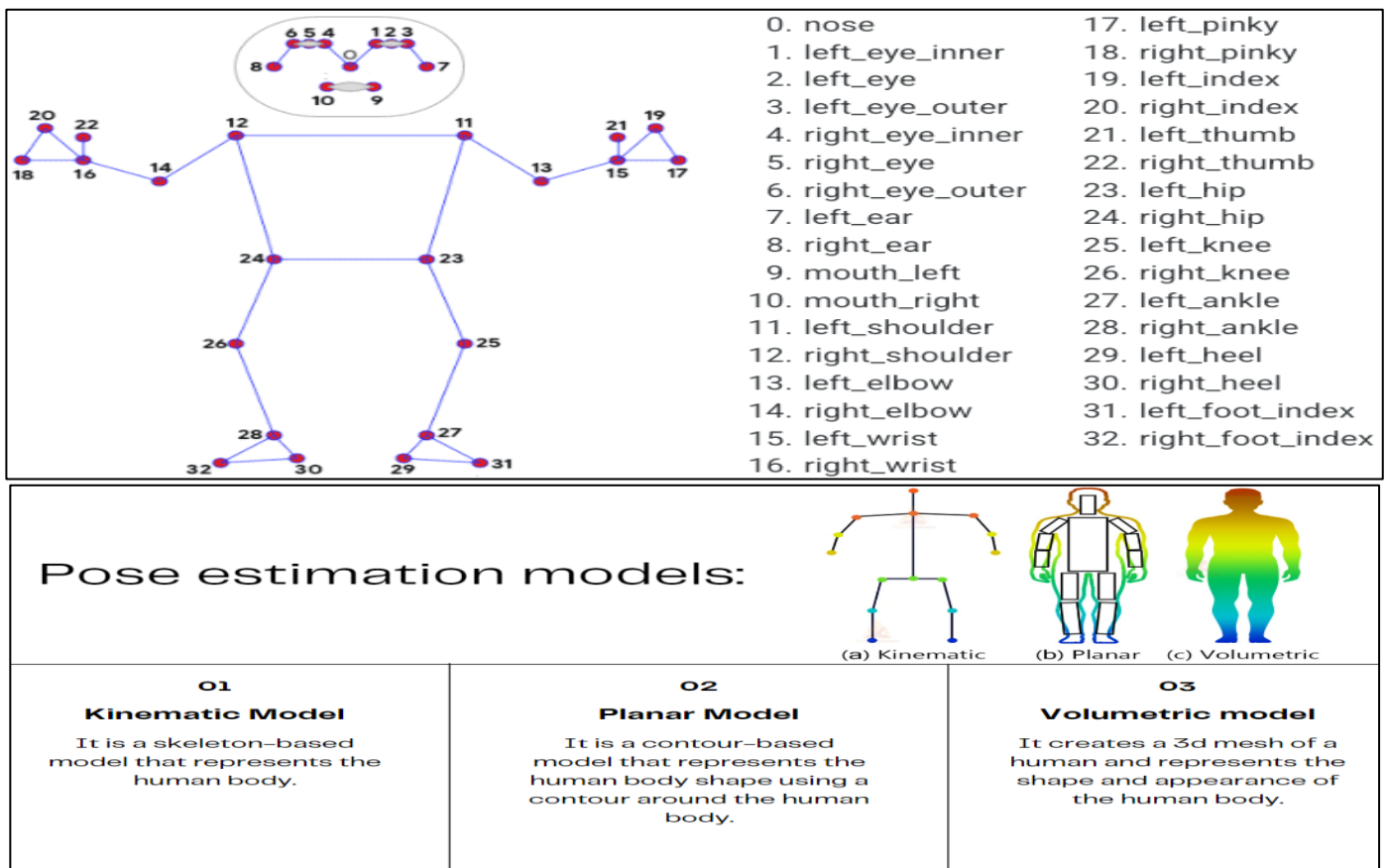


Fig 2: Pose Estimation Model

The next crucial aspect of the AI gym Trainer is its user interface, which serves as the primary interaction point between the user and the system. Utilizing the Tkinter library, we have designed an intuitive and visually appealing interface that facilitates seamless navigation and interaction. The interface features prominently labeled buttons for various exercises, categorized by targeted muscle groups, allowing users to easily select their desired workout routines. Additionally, the interface incorporates a diet planner button, enabling users to initiate web-based interactions for accessing additional functionalities and managing preferences regarding the meal and nutrition. To extend the functionality of the AI Gym Trainer beyond the local environment, we have integrated a Flask web server component, enabling remote interactions and data management. The Flask server hosts a range of endpoints, each catering to specific functionalities such as accessing workout history, setting preferences, and querying the food database. Through these endpoints, users can seamlessly interact with the system from any web-enabled device, facilitating convenient access to personalized fitness guidance and nutritional information. The Flask server architecture ensures scalability and robustness, accommodating concurrent user requests and facilitating seamless communication between the client-side interface and the server-side logic. We have utilized the JSON data serialization for storing user-related data such as workout logs, preferences, and nutritional information. Structured data formats ensure easy retrieval and manipulation, enhancing user experience and system efficiency.

VI. WORKING

This project has a Graphical User Interface (GUI) built with Tkinter for exercise tracking, a Flask-based web application for diet planning, and utilizes Mediapipe's pose estimation model for exercise monitoring. The GUI, developed using Tkinter, offers users multiple options for tracking exercises. It includes features such as curl counting, shoulder press, deadlifts, jumping jacks, and squats. Each exercise option is represented by a button that users can click to log their workout sessions. The diet planner component of the project is a Flask-based web application. It allows users to plan their meals, track their food consumption, and obtain nutritional information about different foods. The application integrates with the Nutritionix database to retrieve accurate nutritional values for various food items. The AI component of the Flask application assesses the quality of food selected by users based on its nutritional content. Leveraging data from Nutritionix, the AI evaluates whether a particular food item is suitable for consumption, considering factors such as protein, carbohydrates, and fats content. To monitor exercises accurately, the project utilizes Mediapipe's pose estimation model. This model analyzes video input from the user's camera to detect key body joints and track movement during exercises. By capturing and analyzing user movements in real-time, the system provides feedback on exercise form and technique.

VII. RESULT

These are the results we achieved after developing the application. The result shows the GUI, Exercise Tracking through real-time video feed and snapshots of Diet Planner.



Fig 3: Graphical User Interface

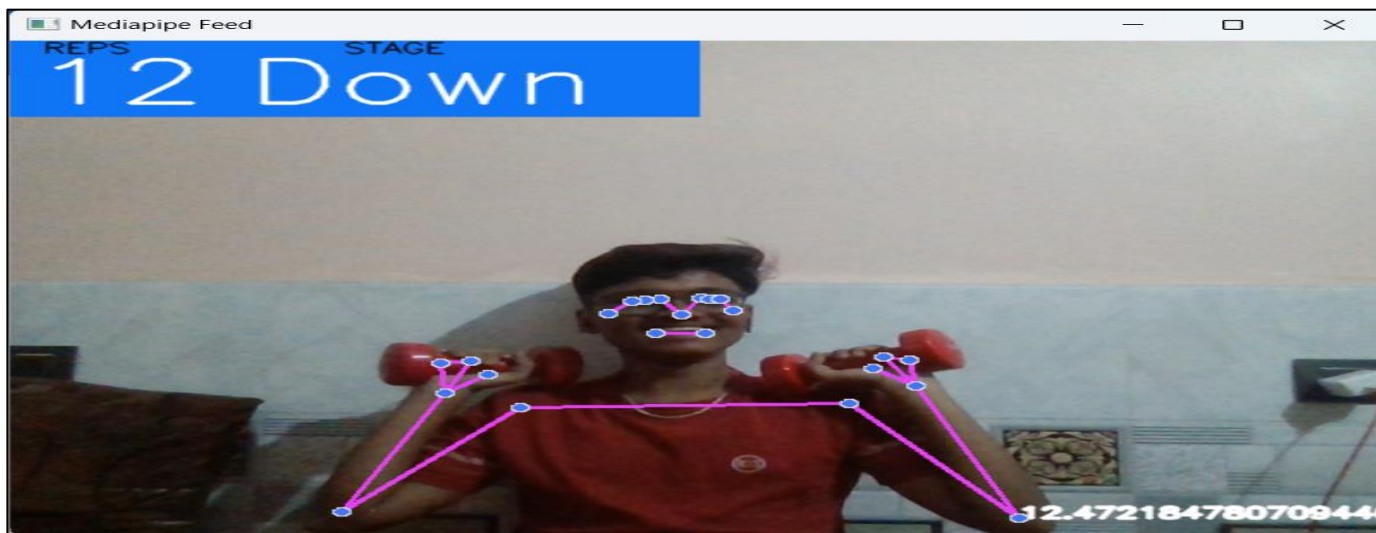


Fig 4: Shoulder Press



Fig 5: Curls Counter

Table 1: Meal Information

Search Result						
Name ▲	Serving Size[g] ▾	Calories[kcal] ▾	Carbohydrate[g] ▾	Protein[g] ▾	Fat[g] ▾	Action ▾
chicken curry	234.57	243.26	7.52	28.25	10.86	»
rice	158	205.4	44.51	4.25	0.44	»
salad	85	19.98	4.21	1.23	0.2	»

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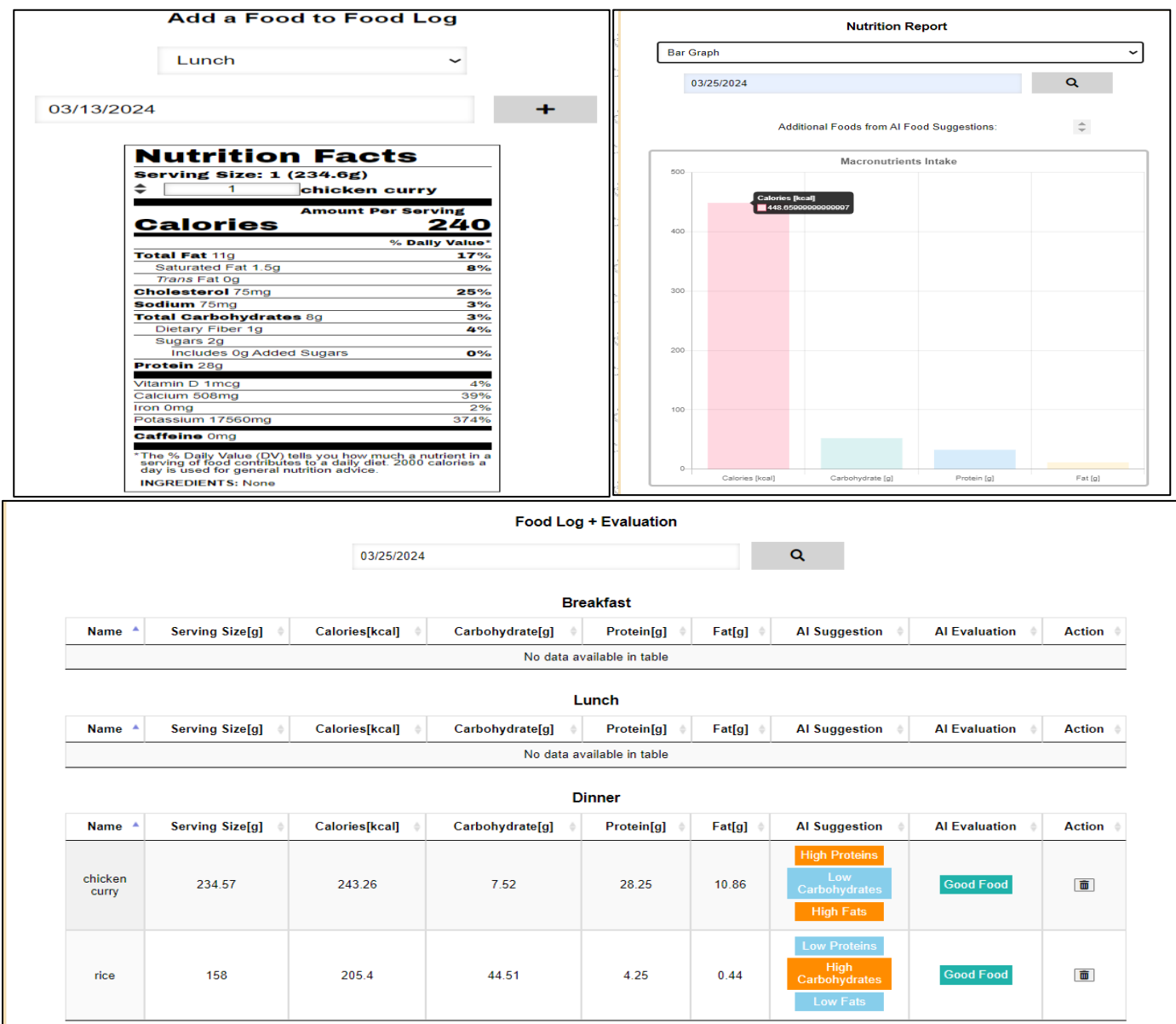


Fig 6: Meal History

VIII. FUTURE SCOPE

The proposed AI Gym Trainer system demonstrates significant potential for expansion and enhancement across various dimensions.

- Integration with Fitness Bands:** Explore integrating the AI Gym Trainer with popular fitness bands and wearable devices to enable seamless tracking of physical activity, biometric data, and sleep patterns. This integration could provide users with comprehensive insights into their overall health and fitness levels, allowing for more informed decision-making and personalized recommendations.
- Augmented Reality (AR) Interface:** Develop an AR-based interface for the AI Gym Trainer, allowing users to visualize workout instructions, correct form, and real-time feedback overlaid onto their surroundings.
- Virtual Personal Trainer:** Implement advanced machine learning algorithms to create a virtual personal trainer within the AI Gym Trainer system. This virtual coach could analyze user data, provide real-time feedback on exercise technique, offer adaptive workout routines, and adjust intensity levels based on user performance and goals, effectively replicating the experience of working with a human personal trainer.
- Integration of Biometric Sensors:** Integrate biometric sensors, such as heart rate monitors and oxygen saturation sensors, into the AI Gym Trainer ecosystem to gather real-time physiological data during workouts. By monitoring vital signs and exertion levels, the system could optimize exercise intensity, prevent overtraining, and ensure user safety, thereby improving the effectiveness and efficiency of fitness programs.

- **Social Features and Community Building:** Expand the AI Gym Trainer platform to include social features such as virtual fitness challenges, online communities, and peer support networks. This social aspect could foster a sense of camaraderie, accountability, and motivation among users, encouraging them to share their progress, exchange tips, and participate in group activities, ultimately enhancing adherence to fitness goals and long-term success.
- **Integration with Nutritional Apps and Services:** Collaborate with nutrition-focused apps and services to enhance the dietary analysis and meal planning capabilities of the AI Gym Trainer. By integrating with comprehensive nutritional databases, meal tracking apps, and recipe platforms, the system could offer personalized dietary recommendations, track macronutrient intake, and suggest healthy meal options tailored to individual preferences and fitness goals.
- **Continuous Research and Development:** Maintain a focus on continuous research and development to stay at the forefront of technological advancements in fitness and wellness. Regular updates and improvements to the AI Gym Trainer system, based on user feedback, emerging trends, and advancements in AI, machine learning, and sensor technology, will ensure its relevance, effectiveness, and competitiveness in the evolving health and fitness landscape.

IX. CONCLUSION

In conclusion, the AI Gym Trainer represents a sophisticated fusion of technology aimed at revolutionizing the fitness journey for users. By seamlessly integrating a user-friendly Graphical User Interface with a Flask-based web application and advanced artificial intelligence algorithms, the project offers a comprehensive solution for exercise tracking, diet planning, and nutritional analysis. Leveraging tools such as Tkinter, Flask, Nutritionix, and MediaPipe's pose estimation model, the system empowers users to monitor their workout sessions, make informed dietary choices, and receive real-time feedback on their exercise form. With its holistic approach to fitness management, the AI Gym Trainer stands as a testament to the potential of technology to enhance personal wellness and support individuals in achieving their fitness aspirations.

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