Enhancing Human Lifestyle using Artificial Intelligence and Machine Learning

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Abstract - In today's fast-paced world, people find themselves managing multiple responsibilities, leading to increasingly dormant lifestyles and erratic eating habits. Despite awareness of the importance of regular exercise, many struggle to find time amidst their busy schedules, resulting in a growing need for accessible and personalized fitness solutions to promote overall well-being. The proposed work presents a comprehensive approach to personalized health and wellness, comprising a diet recommendation system and a yoga pose recognition system. The diet recommendation system employs a two-step process involving K-Means clustering and Random Forest prediction to generate personalized diet plans based on individual characteristics such as height, weight, activity level, and weight goal. Leveraging advanced machine learning techniques, the system provides tailored dietary guidance to optimize health outcomes. In addition, the yoga pose recognition system utilizes pose detection technology and semantic analysis to accurately identify and evaluate yoga poses. Through the integration of the MoveNet model and TensorFlow.js, the system offers real-time feedback and guidance, facilitating effective yoga practice. Together, the system provides a complete approach to health and well-being, helping users make smart food decisions and participate in safe, beneficial workouts.

Index Terms - AI and ML, CNN, MoveNet, OpenCV, Diet recommendation, Pose Estimation, K-means and Random forest

I. INTRODUCTION

In this era of advancements the incorporation of artificial intelligence (AI) and machine learning (ML) has emerged as a ground-breaking revolution, in the realm of machines. This study extensively explores the applications of AI and ML in the field known as AIML with an emphasis, on practical implementation to impact crucial aspects of human life. Our primary focus centres around three areas; meal planning, yoga training and calorie management.

In today's world as countries grapple with increasing health and wellness issues it has become more crucial than to strive for a rounded lifestyle. Within this framework the integration of technology offers an avenue, for creating customized solutions that cater to individual requirements and preferences. The potential impact of AI and ML based applications extends to enhancing the flexibility of service delivery optimizing yoga training effectiveness and simplifying the tracking of caloric intake for individuals adopting an approach, to their well-being.

The research we conducted focuses on three elements; meal planning, yoga instruction and calorie tracking. These components work together to tackle the challenges that individuals encounter while striving for a lifestyle. The meal planner utilizes an AI model to create meal plans that consider nutritional requirements, dietary preferences and health objectives. A distinctive feature of this project involves the use of state of the art camera technology that goes beyond fitness services. With a camera system, in place it is able to identify and analyze the users yoga poses in time providing feedback and guidance, for precise and effective execution.

II. CONCEPT USED

A. K-Means Algorithm:

K-Means is a type of unsupervised learning where the data points are grouped into K distinct, non-overlapping clusters based on their degree of similarity. The objective is to minimize the sum of squared distances between data points and the centroid of the cluster they are assigned to. The algorithm begins by randomly selecting K initial centroids that represent the centers of the clusters. Then it iteratively assigns each data point to the cluster whose centroid is closest and recalculates the centroids based on the newly assigned points. This process goes on until the centroids and the assignment of points to clusters remain unchanged. K-Means aims to create well-separated clusters and the algorithm's efficiency lies in its ability to converge quickly, making it suitable for large datasets. In our project, K-Means helps us to categorize the food items into three clusters breakfast, lunch and dinner. These clusters are formed based on the nutritional content of the food items. The goal is to identify patterns and similarities among food items within each meal category. The algorithm ensures that the food items recommended are as per the user's nutritional requirements.

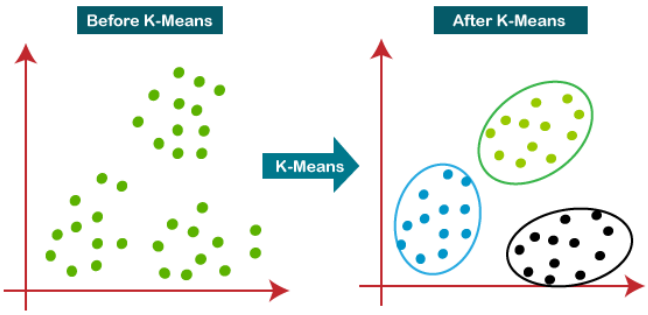

Fig. 1. K-means Algorithm

B. Random Forest Algorithm:

Random Forest is a type of supervised machine learning algorithm used in different recommendation systems. It is an ensemble learning method that combines multiple decision trees to develop a robust and more accurate prediction model. This algorithm can be used to create models that provide suggestions based on user's past behaviour and the behaviour of similar users. The algorithm can examine large datasets and identify trends that can be used to provide personalized recommendations. Random Forest algorithm learns as to which nutritional feature of a food item is important for different health goals. This algorithm in our project predicts what group of food items is suitable for someone based on their health goals like weight loss, weight gain, or just maintaining a healthy lifestyle.

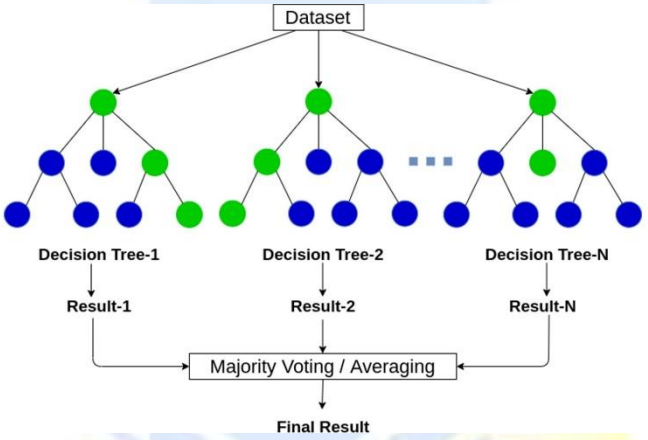

Fig. 2. Random Forest Algorithm

C. Pose Estimation using MoveNet:

Pose estimation is a computer vision technique that involves identifying and locating key body joints or landmarks in images or video frames. It enables the analysis of human posture, movement, and gestures. We have used MoveNet which is an advanced and efficient pose detection model offered on TensorFlow Hub. It employs deep learning techniques, specifically lightweight neural networks, to accurately estimate human body poses in real-time. MoveNet's deep learning model detects 17 keypoints of a body and predicts the positions of joints like shoulders, elbows, and knees, providing confidence scores for each estimation. The system utilizes post-processing techniques for refinement and connects keypoints to form a skeletal structure representing body posture. The model's comprehensive understanding of human poses enhances its utility across diverse fields, providing a dependable and efficient tool for a wide range of pose estimation tasks.

D. Convolutional Neural Network:

Convolutional Neural Network (CNN) is a type of deep neural network that is used in computer vision tasks, such as image and video recognition. They consist of multiple layers which include input layer, convolutional layers, pooling layers, fully connected layers, and output layer. The input layer takes in image data, and convolutional layers use filters to detect patterns like edges and textures, creating feature maps. Pooling layers reduce spatial dimensions while retaining important information. Fully connected layers analyze features for classification. The output layer provides the final prediction. This layered architecture enables CNNs to automatically learn intricate features, making them effective for tasks such as image recognition.

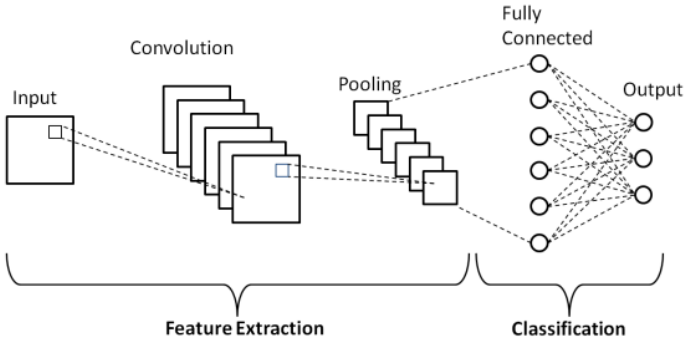

Fig. 3. Convolutional Neural Network

E. Feature Extraction:

Feature extraction involves capturing relevant information from the detected landmarks or key-points on the human body. These landmarks represent specific joints or body parts, such as shoulders, elbows, and knees. Feature extraction aims to extract crucial information from key-points, facilitating efficient representation for classification. Techniques like geometric ratios, distances between key-points, and angles formed by body parts can be extracted as features. By selecting meaningful features, the model gains insights into the spatial relationships and proportions within yoga poses. This process is crucial for training machine learning models to recognize and classify different yoga poses based on the extracted features, facilitating accurate and robust yoga pose estimation. By employing feature extraction in yoga pose estimation, the algorithm can effectively reduce the complexity of pose data, enhancing accuracy and efficiency.

III. LITERATURE SURVEY

1. Yoga Pose Recognition with Real time Correction using Deep Learning:

This research paper represents how computer technology can be integrated with the regular yoga practices as doing proper yoga can have many physical as well as mental benefits. The proposed yoga trainer in the paper is a two-phase project starting with the Backend and followed by the Frontend development. The backend part is divided into three sub-phases:

• Creating a Human Body Instance for developing a Pose Detection Model: This sub-phase defines a class “Body Part” with 17 key points for human body instances associated with image height, weight and key point score.

• Creating a Pose Detection Model based on Person’s scores using TensorFlow Lite Model: This sub-phase makes use of image cropping to enhance keypoint score and to improve accuracy. This is done using the TensorFlow model and Movenet model.

• Finding Range and Accuracy of each Yoga Pose using a Distance Function: This sub-phase uses euclidean distance to measure distances between key points and pose center assisting pattern recognition of the seven poses defined. It stores keypoints scores for each pose in different csv files.

2. Deep Learning Based Yoga Pose Classification:

This paper emphasizes the benefits of the yoga but also recognizes the potential harm caused by the incorrect postures performed. So, It introduces the yoga pose grading system to recognize and assess the quality of poses, addressing to the beginners problems in the self- study. To overcome the scarcity of yoga instructors, the proposed solution involves a technology-based approach using computer vision and deep learning. The classification model is developed using TensorFlow and transfer learning which aims to correctly identify the poses enabling users to practice yoga by themselves. The proposed classification model involves generation of accurate dataset and then processing the data from dataset to improve the accuracy, quality, consistency, timeliness, believability, and interpretability. Key tasks in data preprocessing involve cleaning, integration, reduction, and transformation. The paper highlights the need of data augmentation using Roboflow software for resizing, converting to greyscale, auto-adjusting contrast, and various augmentation techniques. The importance of transfer learning, specifically CNNs and the VGG-19 architecture, is highlighted for effective image analysis. Pre-trained models, such as VGG-19, are mentioned for their ability to classify images into numerous categories, enhancing the overall efficiency of the recognition model.

3. Real Time Detection And Classification Of Yoga Pose Using TensorFlow MoveNet:

This paper introduces a real time yoga pose classification system using computer vision techniques, aiming to provide users with immediate feedback on their pose correctness. The system uses TensorFlow, MoveNet to accurately classify poses based on video input from the webcam. The proposed web application has a user-friendly interface accessible from any device. The methodology proposed uses deep learning techniques like TensorFlow and MoveNet which are known for their accuracy in detecting keypoints from the human body and are used to extract key points crucial for recognition of yoga poses. The process involves collecting and preprocessing a dataset of images showcasing various yoga poses and then extracting key points from it. These keypoints are converted into CSV files and fed into a neural network and the network is trained using the preprocessed data and integrated to the web application built using react framework. The application accepts the input extract key points, classifies the poses and returns the predicted pose to the user.

4. Diet Recommendation using Predictive Learning Approaches:

This paper emphasizes the importance of a balanced diet and its impact on the individual's health. The author proposes various machine learning algorithms to prescribe the personalized diet based on the various factors. The methodology employs taking into consideration various inputs from users like weight, age, gender and dietary preferences and the system suggests personalized list of food items for breakfast, lunch and dinner. It utilizes k-means clustering algorithms to group foods based on the nutrients suitable for healthy, underweight and overweight users. Classifiers such as random forest, support vector machine, AdaBoost, and gradient boost are employed to predict food items based on the user's health status. Python and Tkinter is used for building the graphical user interface, with the Scikit-Learn library used for machine learning algorithms. The dataset used in the system is sourced from kaggle and nutrient values like calories, fat, and carbohydrates are considered for recommendation.

5. Diet Recommendation For Patients Using K-Means:

This paper emphasizes a system that provides personalized recommendation of food items for the diabetic patients based on their health status. For developing this system various machine learning algorithms are used such as k-means and classification algorithms. It also highlights the importance of the data mining concept for extraction of the hidden patterns from the dataset to provide accurate dietary for the diabetic patients.

6. Website on Diet Recommendation Using Machine Learning:

This paper highlights the importance of the adequate diet and the problems caused by the inadequate diet. The author put forward a website that provides a personalized diet to the users based on their preferences. The recommender system takes inputs such as weight, age, gender, body fat percentage and preferences like weight gain or lose and recommends the list of food items for breakfast, lunch and dinner. The k-means algorithm is used to form clusters based on preferences (weight gain or lose) and random forest is used to classify the food items based on the preferences. The output is displayed on the user-friendly graphical interface which is designed using HTML and CSS.

IV. PROPOSED METHODOLOGY:

Our project includes two main parts: recommending diets based on user details and estimating yoga poses using the MoveNet TensorFlow model.

To start with, we have built a diet recommendation model which uses a two-step approach involving clustering using KMeans and prediction using Random Forest. We first gather user's input such as their height, weight, age, body fat percentage, gender, daily activity level (very light, light, moderate, heavy, very heavy), and their weight goal (weight loss, weight gain, or weight maintenance). A body fat percentage calculator is also made available in case the user is not aware of their body fat percentage. The dataset used consists of information about various food items, their nutritional content and the categorization like whether it's suitable for breakfast, lunch, or dinner. Now, three functions are defined based on the user's goal (weight loss, weight gain, or maintaining healthy weight). Each of these functions follows a similar workflow. It first separates the food items into categories for breakfast, lunch, and dinner based on the dataset. Then Body Mass Index (BMI) of the user is calculated based on their height and weight. K-Means clustering is applied to group food items based on their nutritional content, identify patterns and create distinct user profiles. The Random Forest classifier is trained and used to predict suitable food items for the user's goals. The predicted food items along with the user's BMI are returned as recommendations through an interactive interface. The user has the option to select food items from the suggested recommendations, enabling them to organize their daily meals effectively while also monitoring their calorie consumption. This system employs machine learning techniques such as clustering and classification to provide personalized diet recommendations tailored to the user's goals and nutritional needs.

Next, we have built a yoga pose recognition system that compiles a diverse image collection of various poses, featuring individuals of different body shapes and backgrounds. Leveraging the MoveNet model for accurate pose detection, we normalize key points across diverse body sizes and positions. Extracting essential information from these pose landmarks enhances the model's precision. Created with carefully curated data, the adaptable machine learning model regularly updates for optimal performance. Applied via TensorFlow.js, the system provides real-time feedback through a user-friendly interface, displaying images, performance reports, and timers for each pose. User engagement and feedback drive continuous improvements, ensuring an effective and open system for diverse applications in exercise and well-being.

1	Food_items	Breakfast	Lunch	Dinner	Calories	Fats
2	Asparagus C	0	1	1	22	0.2
3	Avocados	1	0	0	160	15
4	Bananas	1	0	0	89	0.3
5	Bagels made	0	1	1	250	1.5
6	Berries	1	0	0	349	0.4
7	Brocolli	0	1	1	25	0.5
8	Brown Rice	0	1	1	362	2.7
9	Cauliflower	0	1	1	32	0.3
10	American ch	1	0	0	331	24
11	Coffee	1	0	0	2	0
12	Corn	1	1	1	97	1.4

Fig. 4. Dataset Screenshot

V. BLOCK DIAGRAM:

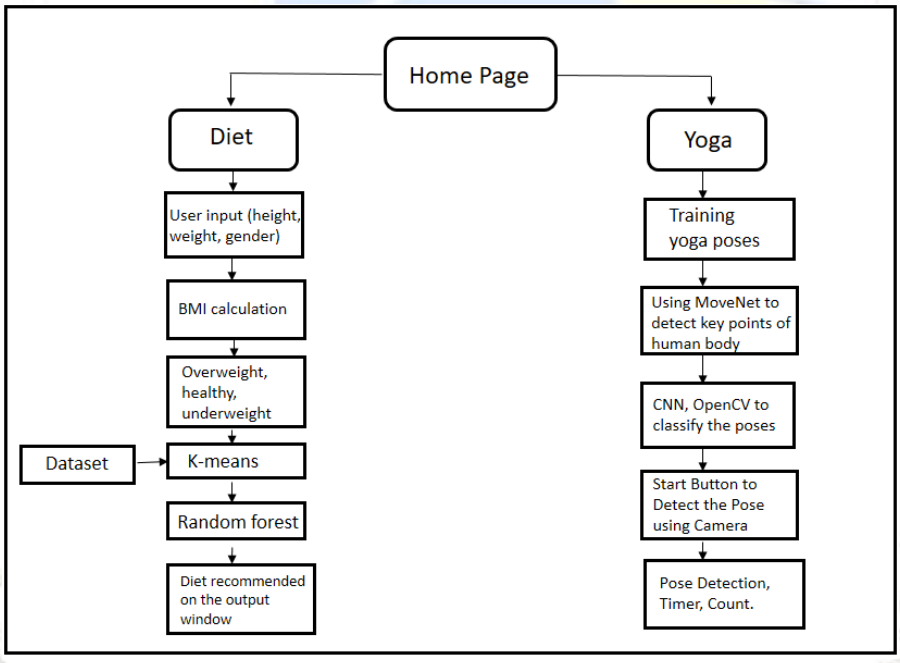

Fig. 5. System Flow Diagram

VI. RESULTS:

We've crafted a personalized health and wellness solution harnessing the power of AI and ML technologies, integrating a diet recommendation system and a yoga pose recognition system. This holistic approach demonstrates significant effectiveness in improving human lifestyle. Our diet recommendation system meticulously sorts a variety of food items into breakfast, lunch, and dinner options using K-Means clustering, ensuring alignment with user preferences and health objectives. By employing Random Forest prediction, we deliver tailored recommendations based on individual characteristics such as height, weight, age, body fat percentage, gender, daily activity level, and weight goal, empowering users to make informed food choices and manage calories effectively. Meanwhile, our yoga pose recognition system, driven by cutting-edge pose detection technology like the MoveNet model, offers real-time feedback on yoga poses, promoting correct posture and alignment during practice. With a user-friendly interface enhancing usability, our solution fosters seamless engagement and long-term commitment to healthier habits, ultimately enhancing overall well-being and quality of life.

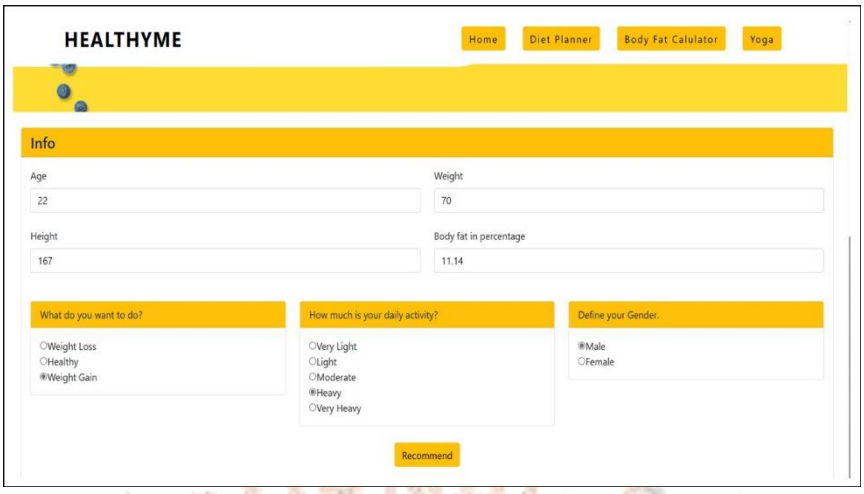

Fig. 6. User Inputs

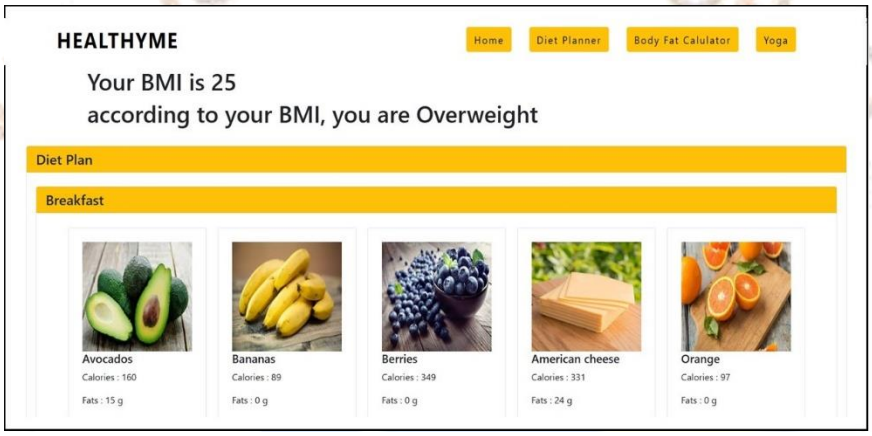

Fig. 7. Diet recommendation based on inputs

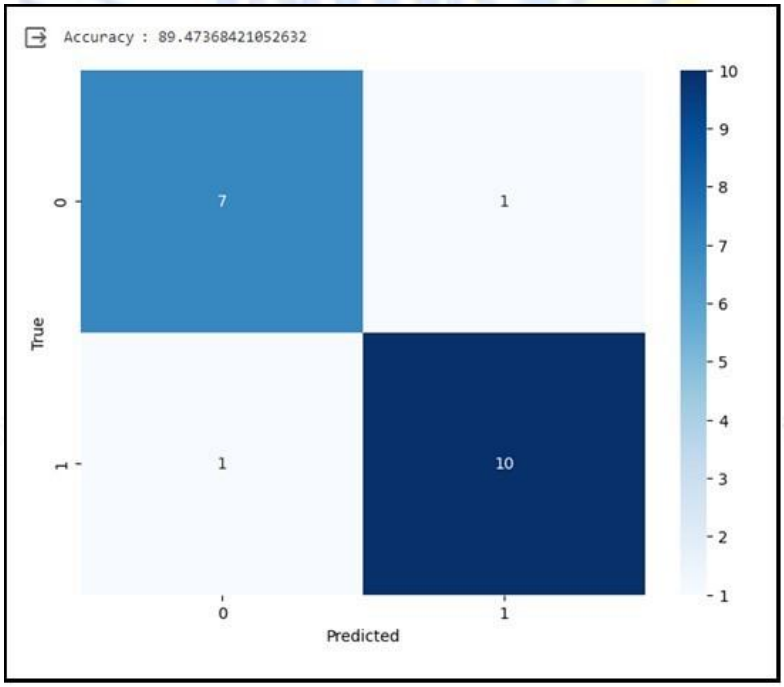

Fig.8. Confusion Matrix indicating the accuracy

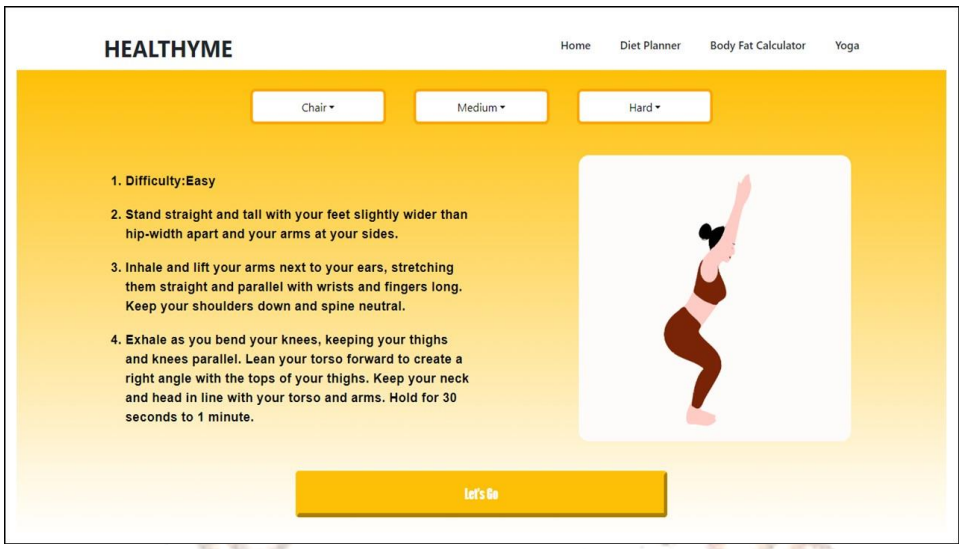

Fig.9. Yoga Model

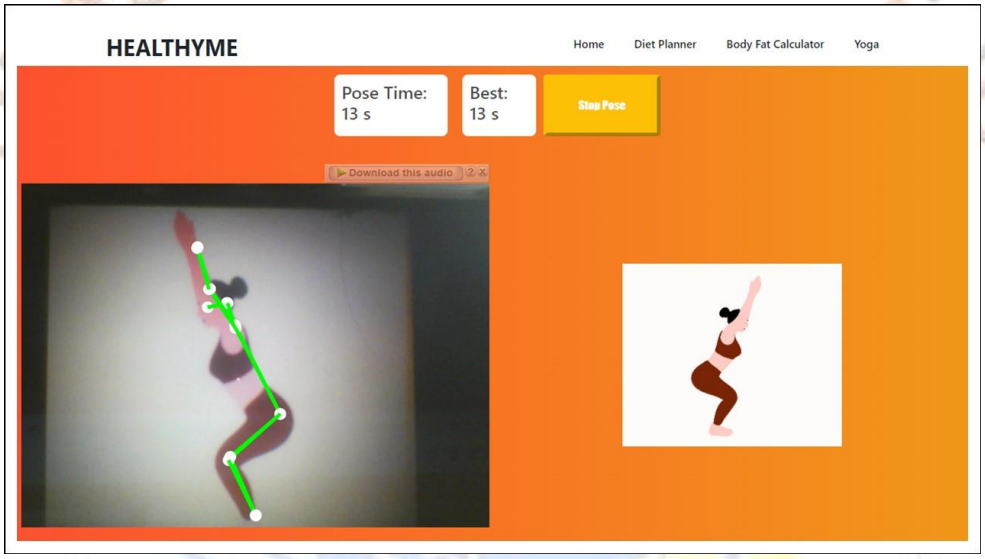

Fig.10. Pose estimation using MoveNet

VII. CONCLUSION:

In conclusion, the use of artificial intelligence and machine learning in enhancing human lifestyle has been prominent. The use of deep learning technologies like neural networks have been very useful for the pose estimation and extraction of key-points of the human body in the yoga model, allowing for faster and more accurate results. The use of machine learning algorithms like k-means and random forest are used for recommending the accurate diet based on the user inputs. By leveraging React for an intuitive interface and Machine Learning for personalized guidance, the project aimed to offer users an overall solution for managing their well-being. The use of AI-based systems for real-time yoga pose recognition and feedback showcased the potential for technology to enhance health and fitness experiences. Regardless of the positive results, there are still challenges in the development and application section of the model. The model can be trained more rigorously to improve the accuracy, enhancement of the machine learning algorithms used to produce more accurate results. Incorporating user feedback loops could be valuable for refining recommendations and enhancing user satisfaction. Overall, the project holds great potential in improving the human lifestyle.

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