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AI-BASED FITNESS TRAINER APPLICATION

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ABSTRACT

Due in large part to the recent COVID-19 outbreak, more individuals than ever are working out in the comfort of their own homes. Since going to the gym in person is discouraged or not an option for many people, no-contact fitness instruction is in high demand. Many fitness-related video tutorials may be found online to cater to this growing market. However, neither system actively engages with the user, nor provides any feedback in real time. We present an artificial intelligence-powered fitness tracker (AI Fitness Coach) that can provide in-the-moment feedback and instruction. A pose recognition device, a fitness movement analysis unit, and a feedback unit make up the AI Fitness Coach. The user makes use of a stationary camera to record their image. The collected image is analysed by the posture recognition unit, which then sends the result on to the fitness movement analysis unit for further processing. NUFI-Nutrition & Fitness's mission is to provide people with all the advantages of having a personal trainer right in their own homes.

Keywords: Artificial Intelligence, Tensorflow, Fitness, Diet Recommendation

1. INTRODUCTION

The developers included a thoughtful Workout Assistant that tailors nutrition advice to each user's needs so that they can keep their bodies in peak condition. By encouraging safe exercise form, this product can help its users prevent unexpected injuries. The goal of NUFI-Nutrition & Fitness is to give customers with a fitness trainer that can be used in the comfort of their own homes or in a traditional gym. A healthy diet plan and guidebook are also provided. Whether you choose to exercise in the privacy of your own home or in a commercial gym, our web-based software can help you get the most out of your workouts. In this study, we want to create an AI system that can monitor your fitness development by analysing your postures and keeping count of your repetitions during your workouts. Customers will find that using this project is more of a pleasure than a bother because to the intuitive design.

2. LITERATURE SURVEY

Numerous apps are available to help beginners learn how to do yoga poses correctly. While some programmes may just instruct users on which exercises to perform, ours uses computer vision to keep count of the user's reps and inspect their form while they work out. Because it monitors the user's posture and provides dietary suggestions, the NUFI app might be seen as a personal trainer. If the NUFI is used more widely, human trainers may become unnecessary in commercial gyms, or at least be reduced to a much smaller role. We suggested using a convolutional neural network that was trained to recognise and categorise essential points and provide reliable results, after first analysing the relative displacements and, by extension, by clustering or recognising the group of distinct significant

points. In this research, we used web-based lightweight convolutional neural network (CNN) architecture for human posture prediction to achieve our goal of providing a broad variety of postures. Over 20 frames per second may be processed on a webpage, giving rise to 17 unique body critical points. Real-time applications using NUFI include fitness tracking and sign language recognition. Specifically, we bring a novel method for sensing body posture and a lightweight neural network for forecasting body postures to the table. Both utilise a mix of map viewing and regression to pinpoint the nodes. The accuracy of posture predictions was considerably enhanced using a proprietary approach that included CNN and a collection of up to 600 images depicting various body parts.

The given method employs BlazeFace and BlazePalm, and is functional for 17 keypoint topologies. As part of this research, we offer a system developed on the Tensorflow architecture that can locate 17 key anatomical landmarks. Identifying postures in a large group of people in real time might be challenging, but the researchers in this study proposed a fantastic way to overcome these difficulties. The model is educated to identify user-provided points and then split and maintain them based on the accuracy bands of different points in the frame. One benefit of this bottom-up approach is that its accuracy and performance are not affected by the number of people in the shot. The 188-frame image dataset has a speed boost of 6.5% mAP compared to the previously described approaches. An enhanced accuracy in close to real-time is possible with this method. As new information was acquired, the previously provided explanations were given new meaning. The primary downsides of Open Pose are its high compute needs and the fact that it does not supply depth data.

3. SYSTEM ARCHITECTURE

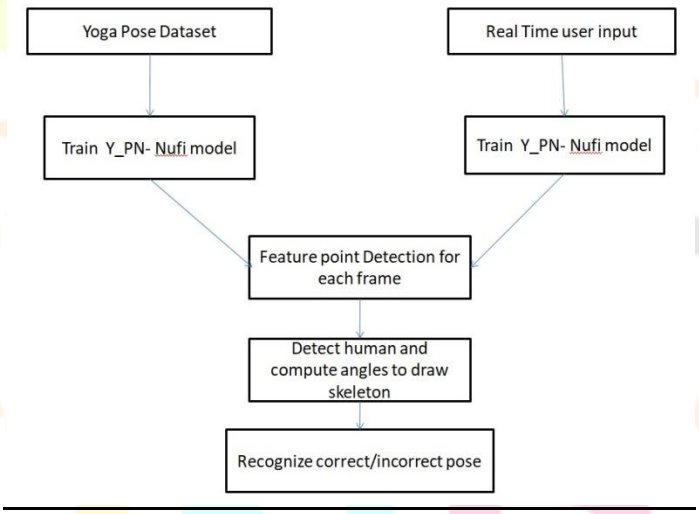


Fig. System Architecture

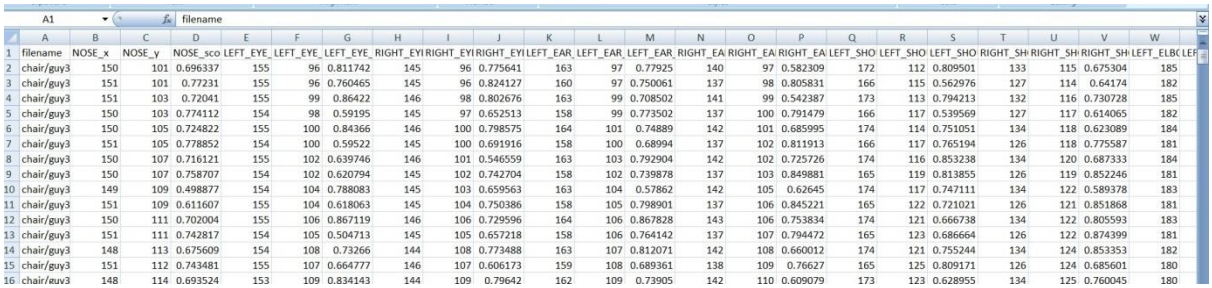
3.1 MODULES DIVISION

1. **User Login/Register**: The user must provide authentic credentials in order to access the NUFI and store any relevant information about them.
2. **Exercises**: The NUFI application contains different yoga poses that the user can do in real time and has various pose corrections and set a repetition counter.
3. **Repetition counter**: It counts the set of repetitions the user does of a particular pose in real time by identifying the position of the user.
4. **Pose corrector**: Using a variety of pose-detecting algorithms and computer vision approaches, it aids the user in identifying and adjusting their workout posture in real time. .
5. **Diet Recommendation**: The system prepares a diet plan for the user depending upon their BMI.

3.2 DATASET USED

We must first collect alignment data for each and every posture because the majority of approaches rely on these landmarks. Multiple scenarios can be used as examples provided the full body is in view and key points for each body component can be identified. Only

250 of the 600 photographs in the training package are stills of the user performing the real workout; the other images show several permutations on the same stance.



filename	NOSE_x	NOSE_y	NOSE_sco	LEFT_EYE_	LEFT_EYE_	LEFT_EYE_	RIGHT_EYI	RIGHT_EYI	RIGHT_EYI	LEFT_EAR_	LEFT_EAR_	LEFT_EAR_	RIGHT_EA	RIGHT_EA	RIGHT_EA	LEFT_SHO	LEFT_SHO	LEFT_SHO	RIGHT_SH	RIGHT_SH	RIGHT_SH	LEFT_ELB	LEF
chair/guy3	150	101	0.696337	155	96	0.811742	145	96	0.775641	163	97	0.77925	140	97	0.582309	172	112	0.809501	133	115	0.675304	185	
chair/guy3	151	101	0.77231	155	96	0.760465	145	96	0.824127	160	97	0.750061	137	98	0.805831	166	115	0.562976	127	114	0.64174	182	
chair/guy3	151	103	0.72041	155	99	0.86422	146	98	0.802676	163	99	0.708502	141	99	0.542387	173	113	0.794213	132	116	0.730728	185	
chair/guy3	150	103	0.774112	154	98	0.59195	145	97	0.652513	158	99	0.773502	137	100	0.791479	166	117	0.539569	127	117	0.614065	182	
chair/guy3	150	105	0.724822	155	100	0.84366	146	100	0.798575	164	101	0.74889	142	101	0.685995	174	114	0.751051	134	118	0.623089	184	
chair/guy3	151	105	0.778852	154	100	0.59522	145	100	0.691916	158	100	0.68994	137	102	0.811913	166	117	0.765194	126	118	0.775587	181	
chair/guy3	150	107	0.716121	155	102	0.639746	146	101	0.546559	163	103	0.792904	142	102	0.725726	174	116	0.853238	134	120	0.687333	184	
chair/guy3	150	107	0.758707	154	102	0.620794	145	102	0.742704	158	102	0.739878	137	103	0.849881	165	119	0.813855	126	119	0.852246	181	
chair/guy3	149	109	0.498877	154	104	0.788083	145	103	0.659563	163	104	0.57862	142	105	0.62645	174	117	0.747111	134	122	0.589378	183	
chair/guy3	151	109	0.611607	155	104	0.618063	145	104	0.750386	158	105	0.798901	137	106	0.845221	165	122	0.721021	126	121	0.851868	181	
chair/guy3	150	111	0.702004	155	106	0.867119	146	106	0.729596	164	106	0.867828	143	106	0.753834	174	121	0.666738	134	122	0.805593	183	
chair/guy3	151	111	0.742817	154	105	0.504713	145	105	0.657218	158	106	0.764142	137	107	0.794472	165	123	0.686664	126	122	0.874399	181	
chair/guy3	148	113	0.675609	154	108	0.73266	144	108	0.773488	163	107	0.812071	142	108	0.660012	174	121	0.755244	134	124	0.853353	182	
chair/guy3	151	112	0.743481	155	107	0.664777	146	107	0.606173	159	108	0.689361	138	109	0.76627	165	125	0.809171	126	124	0.685601	180	
chair/guy3	148	114	0.693524	153	109	0.834143	144	109	0.79642	162	109	0.73905	142	110	0.609079	173	123	0.628955	134	125	0.760045	180	

Id	Part
0	nose
1	leftEye
2	rightEye
3	leftEar
4	rightEar
5	leftShoulder
6	rightShoulder
7	leftElbow
8	rightElbow
9	leftWrist
10	rightWrist
11	leftHip
12	rightHip
13	leftKnee
14	rightKnee
15	leftAnkle
16	rightAnkle

3.3 IMPLEMENTATION AND ALGORITHM

We use **JavaScript**, **ReactJS**, and different libraries such as **Open CV** and **Tensor Flow**

The key points are located using a 17-point technique once a Tensorflow-trained posture classification model has been constructed. Pose Net is a deep learning Tensorflow model that allows you to estimate and track human poses (known as "pose estimation") by detecting body parts such as elbows, hips, wrists, knees, and ankles. Our proposed approach employs a CNN, or Convolution Neural Network, to discover and categorise the important points and provide accurate results by analysing the relative displacements and, in turn, grouping or identifying the group of varied posture samples.

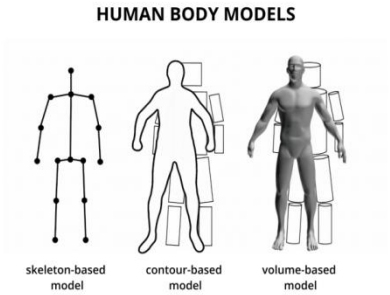
We imported the PoseModule.js file into the main project file, aiTrainer.js, so that we could make use of the functions it defines. After calculating the angular separation, the distance may be determined. One technique to show this range is with a percentage bar ranging from 0 to 100 placed on the last frame of the video. The number of repetitions of the workout are recorded and displayed in the end.

The formula for calculating the angle formed by 3 points:

Angle = math.degrees (math.atan2(y3-y2,x3-x2)- math.atan2(y1-y2,x1-x2))

The output shows a tally of how many times something has been done. This project may be used with both recorded videos and live feeds from a camera.

The **skeleton-based** model is the most used one in human pose estimation because of its flexibility



4. DESIGN

1. USE CASE DIAGRAM

Primary Actors: Users

Secondary Actors: AI trainer, Admin

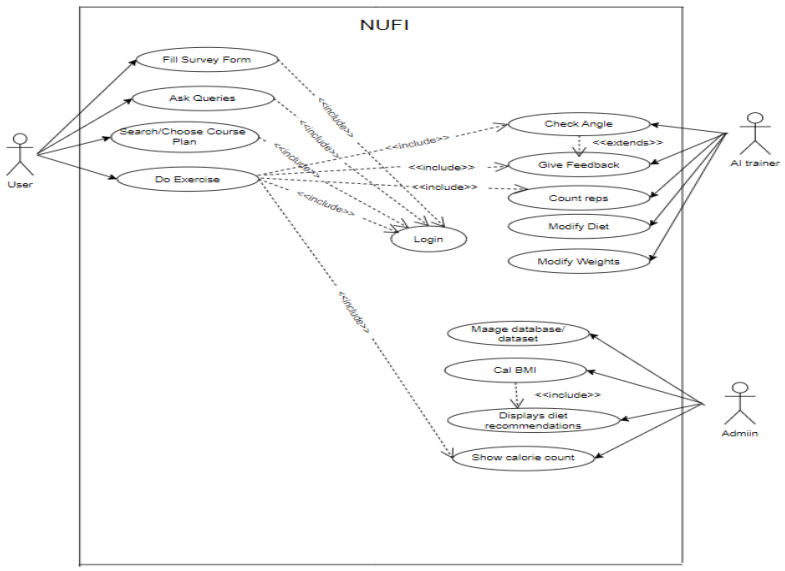
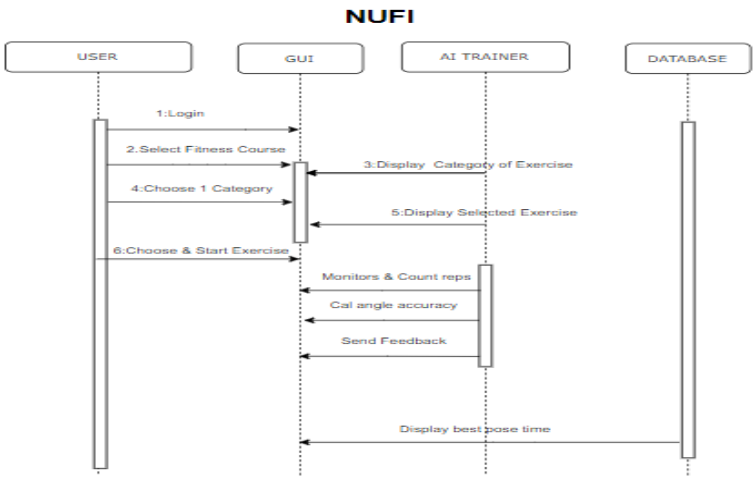


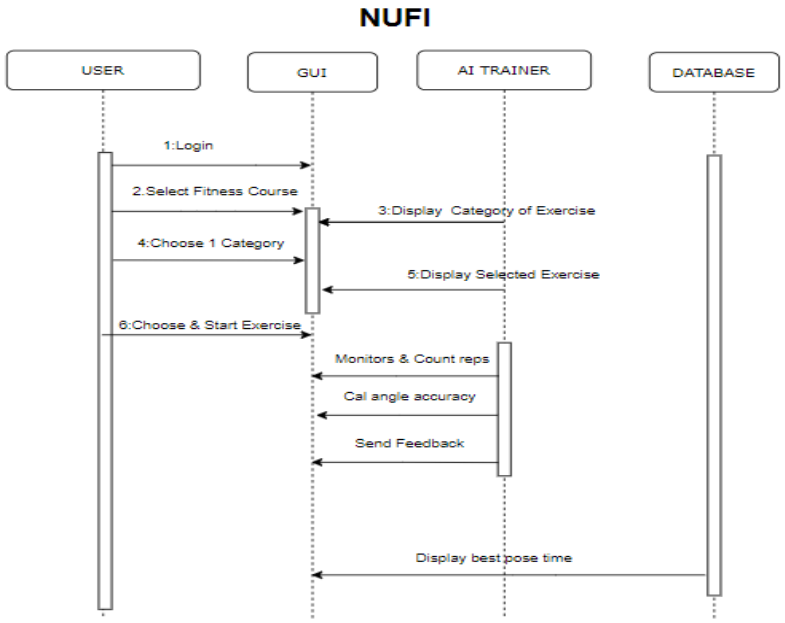
Fig.Use Case Diagram

2. SEQUENCE DIAGRAM

For Diet planning:



For Fitness Planning:



3. CLASS DIAGRAM

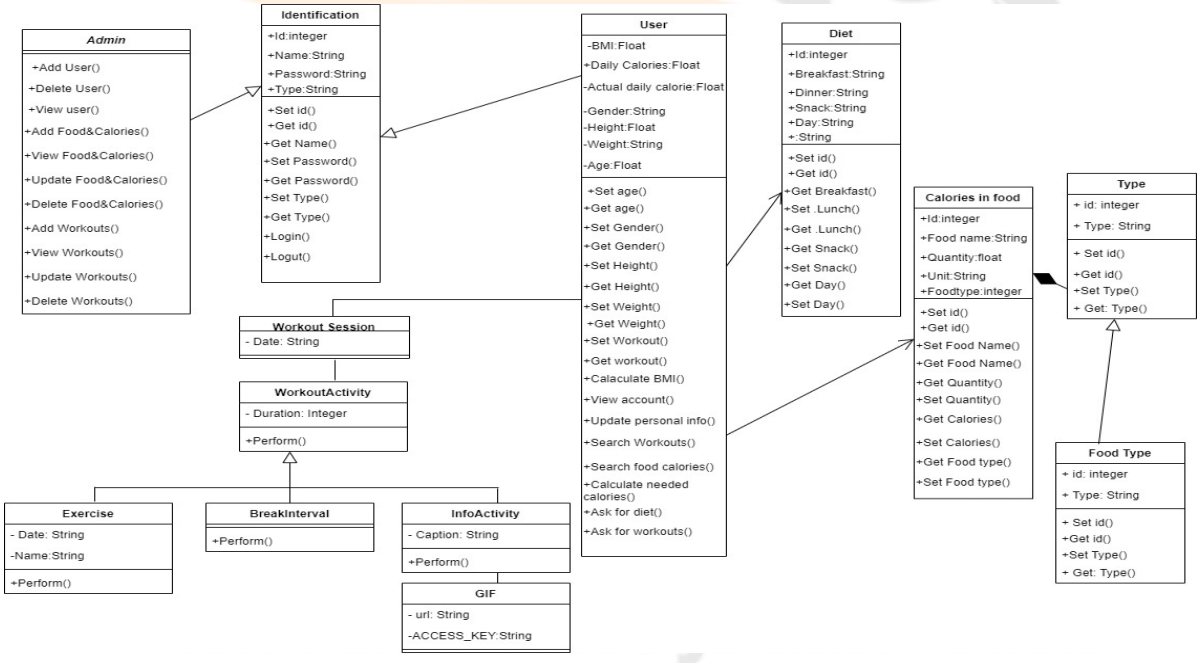


Fig. Class Diagram for NUFI

4.1 FUNCTIONAL REQUIREMENTS

1. Pose estimator can detect the pose and count the repetitions along with the posture guide

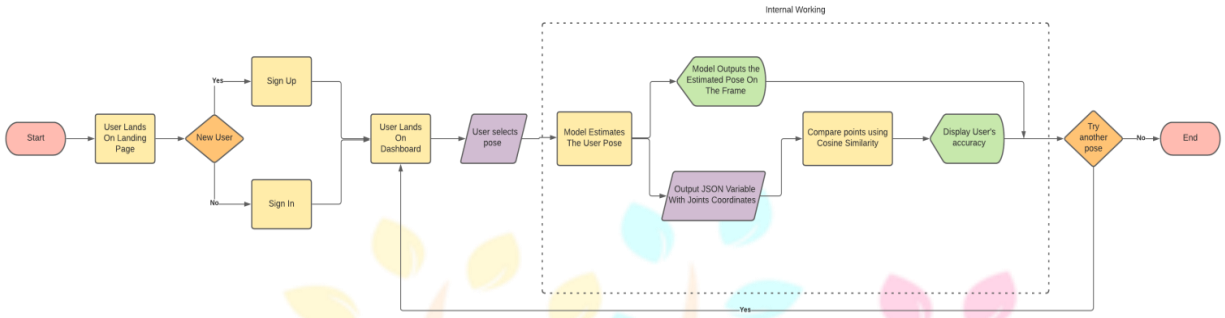
2. Diet planners exhibit different diets depending upon the health conditions and calorie Intake.

3. Display different exercise routines according to the health conditions and focus majorly on being fit and weight loss

5. INPUT AND EXPECTED OUTPUTS

INPUT: For this task, we'll use as input photographs or videos of people engaging in a variety of physical activities or stances. Using Tensorflow, we are first extracting the video's landmark points on the body.

PROCESSING: From 0 to 360 degrees, the AI trainer will use a method to select an interval based on the values in the training dataset. An effectiveness bar reading 0%–100% superimposed on the final video frame is one way to illustrate this spectrum. In the final movie, we also include a counter showing how many times the exercise was performed.



OUTPUT: In the output following data is displayed: counter for repetitions

Accuracy = **Number of correct predictions / Total number of predictions**

For binary classification, accuracy can also be calculated in terms of positives and negatives as follows:

Accuracy = TP+TN TP+TN+FP+FN

Where TP = True Positives, TN = True Negatives, FP = False Positives, and FN = False Negatives

6. CONCLUSION

We propose an AI-powered fitness tracking system (AI fitness coach) to offer immediate feedback and advice throughout workouts. Both the posture detection and fitness motion analysis sections function as intended. The experimental outcomes validate the efficiency and practicality of the suggested approach. They prove that the system is reliable and that the progress made on the function library is worthwhile, which will save developers a lot of time. The function library allows even non-coders to contribute to the growth of contactless fitness by editing and adding or adjusting movement poses in CSV files. When compared to the state-of-the-art approaches, the suggested method yields equal and encouraging results.

7. FUTURE WORK

While the generated prototype functions satisfactorily, the terminal adaptability must be optimised through extensive effort and modifications in order to realise the following solutions.

1. Swap out the human body detection system for a newer, more accurate one in order to speed up the system's operation; the existing human body detection system requires a massive amount of computing power to function.

2. build off of this system's current capabilities to create new applications in the health and wellness, medical rehabilitation, and social service sectors. Second, build off of this system's current capabilities to create new applications in the health and wellness, medical rehabilitation, and social service sectors.

3. Develop personalized diet plans and display progress

4. Add more Yoga Poses and Other Exercises

8. REFERENCES

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