Grenze International Journal of Engineering and Technology, June Issue

Future of Fitness App with Artificial Intelligence

Prof. Sandeep G. Sutar[1], Abhishek Chougule[2], Mayuri Pandhare[3], Vaishnvee Shinde[4], and Chaitali Kadam[5]
[1-5]Annasaheb Dange College of Engineering and Technology Ashta/Computer Science and Engineering, Sangli, India
Email: sutarsandeep07@gmail.com, {chouguleabhis, mayuripandhare01, vaishnvee169, mailtochaitalikadam}@gmail.com

***Abstract*—Throughout the past couple of years, Artificial Intelligence has become one of the most important aspects of human life. There is hardly an industry not affected by AI, whether it be healthcare, retail, mobility, or even the fitness industry. Although it is not too long since artificial intelligence became a component of the fitness industry, it has gained momentum quickly. For those who love to relax, working out can be a challenge. For the same reason, people procrastinate as much as possible when it comes to getting ready and going to the gym. Several applications are available on the play store, such as Cult Fit, Abs workout, Total Fitness, Calorie Counter and others. However, none of these applications provide a free subscription. Regular exercise strengthens your muscles and bones. Improves breathing, cardiovascular and general health. Exercise prevents many chronic conditions like heart disease, high blood pressure, and other chronic diseases. In order to maintain a healthy weight, lose excess weight, or maintain a successful weight loss, diet and physical activity are both crucial. The number of calories consumed through food and drink you consume is greater than the number of calories you burn through exercise. It's necessary to balance calories. So, we are proposing our project as Future of Fitness with AI to keep track of everyone's health. By encouraging users to make positive lifestyle changes, we hope to assist them in pursuing a healthy lifestyle.**

***Index Terms*— Fitness, AI, Diet, Workout, PoseNet.**

I. INTRODUCTION

It is a fresh tackle the way to get active while exercising. It fuses physical activity with interactive exercises. Anyone can find a Artificial intelligence (AI) which will motivate them to exercise and have a fun doing. This AI has you employ already existing landmarks as the simplest way to unravel the story of the Enlightened versus the Resistance. Walking or running from place to place is great motivation. Just place your device in front of you and also the AI translates your body movements into game controls on your screen. Ready to make a choice from an ever-expanding variety for all humans of exercises to play alone and you're able to share your score together with your friends or relations. AI is great for integration with fitness. The app serves as a virtual personal trainer who can guide you in maintaining your fitness and health. Besides helping people stay healthy and fit, artificial intelligence also benefits business by improving their marketing and sales strategies. This largely resides in targeting the correct customer and offering high degrees of personalization and customization. Engaging users in this way empowers the app while also increasing its power. With a rise in engagement comes a rise in revenue additionally. This then results in better services that are offered to the purchasers. Hence, it's a two-fold benefit.

Grenze ID: 01.GIJET.8.2.36

II. Related Work and Literature

Many fitness programs are available for download on the Internet. Some are used to calculate calories, others record exercise statistics or collect data on walking or running, or some software connects the user with a personal trainer or nutritionist to implement routines. Targeted fitness or exercise, in general, can help relieve fear. The goal of our project is to provide all the above features for free with instructions and examples of one or more types of exercise, physical activity, and nutrition programs using artificial intelligence

Personalized virtual fitness trainer [1] As shown in Table II.1, this research describes the design and development of an artificial intelligence-based fitness trainer named Intelligent Virtual Fitness Trainer (IVFIT) to provide users with a customized fitness experience. Cult Fit [2] offers a variety of fitness forms, you can never be "bored" of working out! With their best efforts of offering fitness classes from boxing to yoga, you can choose the workout according to your mood and burn those calories. In Adoption of Health and Fitness Apps by Smartphone Users [3] Based on the interactive qualitative analysis in Table II.I, this research paper describes how mobile health technology (mHealth) enables real-time monitoring and monitoring of health and fitness parameters. The study uses interactive qualitative analysis (IQA), which is a systemic approach, to analyze the factors that influence the adoption of mobile health and fitness apps. Android-based Exercise Application [4] Specifically, this research is focused on developing an Android-based mobile phone prototype that will calculate and determine exercise duration, exercise time, and the types of exercise the user needs every day. The BMI of the user, his or her physical condition, and the number of hours worked will all be factored into the algorithm calculation. Rules-based algorithm was used in this app to suggest your exercise program. PoseNet for iOS, Android and flutter using Tensorflow Lite [6] This research focuses on how PostNet can be used to recognize one or more users. By detecting and connecting the points of elbows, hips, wrists, knees, and ankles from a deep learning TensorFlow model, you can estimate the pose of your body and build a skeletal structure of the pose. This algorithm can be used for estimating single poses or multiple poses, which means that there are versions that can only recognize one person in a photograph or video, and another version that can recognize multiple people in a picture or video.

TABLE II I : COMPARISON OF SELECTED APPROACHES

Paper / Year	Approach Used	Limitations	Dataset	Performance
[1]/2020	AI	Available for specific group of users only	Own dataset	Accuracy 72.5%
[2]/2016	AI+ML	No personalized AI-trainer Paid subscription	Own dataset	Accuracy 85.8%
[3]/2019	Android + ML	Workout recordis not stored	Own dataset	Accuracy 70.8%
[4]/2012	Image Processing	Fails to calculate the actual duration of physical exercise	Own dataset	Accuracy 88.3%
[6]/2019	Image Processing	over-fitted training data and could not generalize well	Own dataset	Accuracy 94.3%

III. PROBLEM STATEMENT AND OBJECTIVES

A. Problem Statement

With COVID 19, individuals have turn to isolate as the final resort to secure themselves from the dangerous virus. As time advances, this will lead to wellbeing issues due to physical dormancy. Corpulence is as of now an awfully enormous around the world wellbeing issue. Physical dormancy can lead to infections, both physical and mental. In these attempting times, any kind of malady can be dangerous and physical movement makes a difference boost insusceptibility and keep maladies away. In this boisterous lifestyle, we all get so active with our every day plan typically where we continuously disregard to require care of ourselves. It is imperative for us to require care of our body and intellect as well. Keeping up redress pose whereas working out is basic, as off-base stances can lead to body issues.

B. Objectives

To design and develop a registration and login system. To design database syatem to track human fitness records. To design and develop a health record monitoring system with AI-based diet plan recommendations. To design and develop AI based personal trainers. To enable voice recognition which engage user in conversation.

IV. METHODOLOGY

A. PoseNet

A version of the algorithm is capable of estimating a single pose, while the other can estimate multiple poses. This means that there is a version that can detect only one person in an image/video, and a version that can detect multiple people in an image/video.

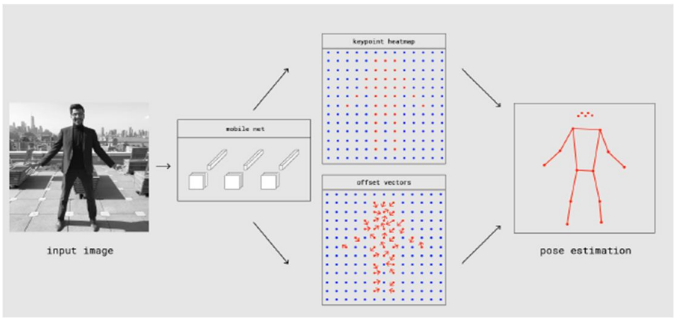

Figure IV.I PoseNet [6]

B. TensorFlow Lite

With TensorFlow Lite, developers can run machine learning models trained on their trained models on mobile devices, embedded systems, and IoT devices, as well as on computers. How PoseNet and TensorFlow Lite Works:

There are two phases to the estimation process:

Input RGB images are fed through a convolutional neural network.

Model outputs are coded depending on the number of poses and confidence scores in the pose, the position of keypoints, and the confidence scores at keypoints

1. In response to a User approaching the camera, the PostNet library takes a picture and provides information about key body parts on the person. With estimate SinglePose(), which runs TensorFlow Lite on a processed RGB bitmap and returns a workout, this functionality can be provided.
2. Pose estimation is a method of detecting human figures in images and videos using computer vision. An image of a processed camera is used as the input for the position estimation models. The key points detected are identified by a part ID. A confidence score is also presented at every key point, ranging from 0.0 to 1.0. The confidence score indicates how likely it is that a key point exists at that position.
3. The confidence score of each key point represents the probability that that key point exists at that position for a given person.
4. The key points include information about a particular body part and the confidence score associated with it.
5. A single Surface View instead of multiple Views was used to display the output to synchronize pose rendering with camera frames. By grabbing, locking, and painting on the canvas without delay, Surface View places the surface on the screen.

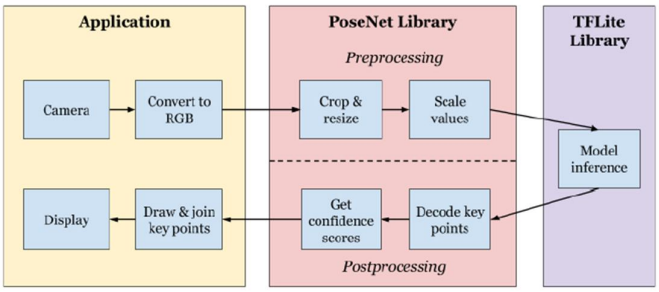

Figure IV.II PoseNet WorkFlow [6]

We took survey of another applications like Map my run application [11], RunKeeper application [12], Strava application [13] and Yoga studio application [14]. This app is available on play store [8]

V. ALGORITHM

Algorithm for getting the keypoints of the pose [6]

Heatmaps : Heat maps are composed of 3D tensors of resolution x resolution x 17 points since 17 is the number of key points found by PoseNet. For example, with an image size of 225 and an output stride of 16, this would be 15x15x17. Each slice in the third dimension (of 17) corresponds to a specific keypoint on the heatmap. Various levels of confidence are assigned to each position in the heatmap, indicating how likely it is that that position contains a component of that keypoint type. A 15x15 grid has been drawn around the original image, and the heatmap scores indicate how likely each keypoint is to be in each square of the grid.

Keypoint: From Figure IV.I and Figure V.I a part of a person's pose that is estimated, such as the nose, right ear, left knee, right foot, etc. It has a position as well as a keypoint confidence score. PoseNet presently identifies 17 keypoints, as seen in the picture below:

Figure V.I Keypoints Returned by PoseNet [6]

A. Dataset

We have used Kaggle Yoga Poses Dataset [7] and our own images for yoga pose detection. In our dataset, we are having 5 classes for 5 different workouts as shown in table below It also demonstrates the total number of yoga pose images that we have used for our application.

TABLE V.A.I YOGA POSES DATASET

Class No	Class Name	No. of Images (Kaggle Dataset)	No. of Images (Own Dataset)	Total Images
1	Downdog Pose	320	1000	1320
2	Godness Pose	260	800	1060
3	Plank Pose	381	698	1079
4	Tree Pose	229	900	1129
5	Warrior Pose	361	3000	3361

Algorithm For Counting Squat.

Input: Image
Output: Number of squats performed
Initialisation :
1: The CountingLogic function is initialized with the default value 0. If the body posture is correct then for ackownledagment the altert lable color changed to green.

```
countingLogic= 0
if (poses != null) {
_checkCorrectPosture(poses);
if (isCorrectPosture && squatUp && midCount == false) {
setState(() {
 whatToDo = Squat Down;
});
 squatUp = !squatUp;
 isCorrectPosture = false; -
```

```
}
2: After performing Squat Down. Once agian value posture is detected. Once it is correct. Color changed to
green.
if (isCorrectPosture && !squatUp && midCount == false) {
 midCount = true;
isCorrectPosture = false;
squatUp = !squatUp;
setState(() {
whatToDo = Go Up;
});
}
3: Counting of number of squats performed.
if (midCount && poses[leftShoulder]![1] < 320 &&
poses[leftShoulder]![1] > 280 &&
poses[rightShoulder]![1] < 320 &&
poses[rightShoulder]![1] > 280) {
 incrementCounter();
midCount = false;
squatUp = !squatUp;
setState(() {
}); }
```

4: Number of correct squats performed displayed on the screen.

VI. RESULT AND ANALYSIS

Application performance indicates however the app is functioning and the way responsive the app is to the end-user. The performance of this application is measured by scheming the time it needs to perform a precise task. The final results of the time taken (in seconds) by the projected methodology area unit are mentioned below.

TABLE VI. I ACCURACY ANALYSIS OF WARRIOR POSE

Index	Keypoint	Score
1	LeftHand Position: x: 113.08767345212, y: 85.236790368826	Score: 0.89768902145323
2	RightHand Position: x: 95.56789053780, y: 89.697823354104	Score: 0.67125726902341
3	LeftLeg Position: x: 270.89545465789, y: 110.243590523967	Score: 0.56390286587342
4	RightLeg Position: x: 256. 34621208747, y: 152.89553698009	Score: 0.61763435623095
5	Head Position: x: 48.0088676512461, y: 103.334528906482	Score: 0.59235690845464

Table VI.I shows the keypoint score for the warrior pose. The table also shows the ideal distance between the right hand, left hand, and legs while performing the pose.

An app's performance describes its functionality and the degree of responsiveness it offers to the end user. By calculating the amount of time it takes to do a specific task we can measure the performance of this application. The partial results of the time taken (in seconds) by the projected methodology area unit are mentioned below.

TABLE VI.II ACCURACY ANALYSIS OF WARRIOR POSE

Pose performed by person	Correctly recognized posture instances	Total instance	Accuracy
A	76	77	98.70
B	72	77	93.51
C	67	77	87.01
D	56	63	88.89
E	77	77	100

Table VI.II shows accuracy analysis of warrior pose. We have taken Index as a different number of users who are performing warrior workouts. We have compared their workout result with the total number of instances. The workout is correctly recognized by calculating the confidence score.

The accuracy of the workout is calculated by using the formula:

Accuracy = (Correctly Recognized Posture Instances * 100)/ Total Instances

TABLE VI.III ACCURACY ANALYSIS OF WARRIOR POSE

Index	Keypoint	Score
1	LeftHand Position: x: 113.08767345212, y: 85.236790368826	Score: 0.89768902145323
2	RightHand Position: x: 95.56789053780, y: 89.697823354104	Score: 0.67125726902341
3	LeftLeg Position: x: 270.89545465789, y: 110.243590523967	Score: 0.56390286587342
4	RightLeg Position: x: 256. 34621208747, y: 152.89553698009	Score: 0.61763435623095
5	Head Position: x: 48.0088676512461, y: 103.334528906482	Score: 0.59235690845464

Table VI.III shows the Keypoint score for the planks. The table also shows the ideal distance between the right hand, left hand, and legs while performing the pose.

TABLE VI.IV ACCURACY ANALYSIS OF PLANK POSE

Pose performed by person	Correctly recognized posture instances	Total instance	Accuracy
A	46	79	58.22
B	35	65	53.84
C	28	61	45.90
D	37	72	51.38
E	29	76	38.15

Table VI.IV shows accuracy analysis of plank pose. We have taken Index as a different number of users who are performing warrior workouts. We have compared their workout result with the total number of instances. The workout is correctly recognized by calculating the confidence score.
Person A's properly recognized posture is 35 out of 65 total instances, the reason for misclassification is that multiple people are visible on the screen which is creating obstacles for posture recognition. While Person B and C performing a workout lots of light occurs in the back so the rate of misclassification is more with an accuracy of 53.84 and 45.90. For the plank pose, Person D has got 37 correctly recognized posture out of 72, the reason for misclassification is the speed of the workout and internet connection slow. Person E workout accuracy is 58.22 the reason for misclassification is that person's workout posture is wrong for longer time.

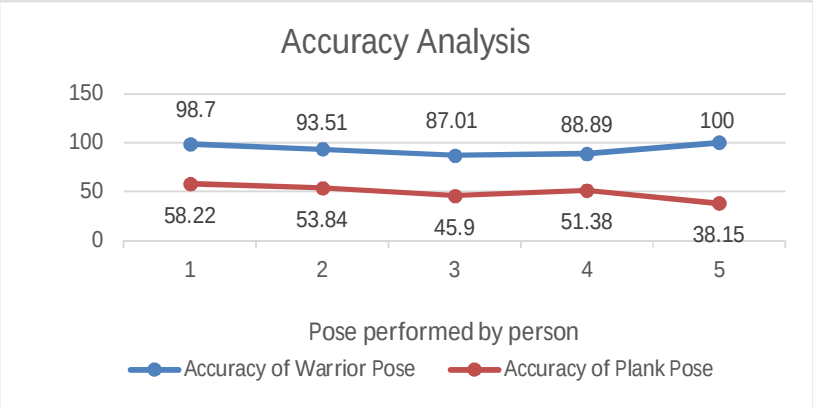

Figure VI.I Comparison between Warrior and Plank pose

Posenet with the help of MobileNet architecture we have calculated the score for the warrior pose. In the Mobilenet architecture, it calculates the heatmap, offset, and matrix for the given input images captured by the mobile camera. We are calculating the score by measuring the key points of the input image with the predefined values. The Keypoint score for the warrior pose is correctly recognized as a posture of the user while performing the work is accurate. The distance between LeftHand, RightHand, Head, LeftLeg and RightLeg is meeting the accepted values.

A. Authentication [7]

We are using 2-factor authentication and email verification which is provided by Google to verify the user. Once the user is authorized and verified then and then only he/she is able to access the application. In this way, authentication is provided to the user.

B. Simplicity [9]

Simplicity testing ensures the functionalities of software system applications work as per specifications by checking screens and controls like menus, buttons, icons, etc. We have also taken one survey to check the application review from each age group and we have also got feedback that our application is simple to use.

C. A user friendly responsive interface [10]

The application must be user-friendly and responsive as it is going to be used by various types of people having different age groups. So while developing the application we have considered various design thinking aspects and developed a user-friendly interface. We have given our application for testing to various users and got feedback as the application is user-friendly and simple to use.

VII. CONCLUSION

In this paper, we have implemented a fitness tracking app which is used to track human fitness records. We have referred to some research papers and found some advantages and drawbacks of the Virtual Fitness App. We overcome issues like the detection of workout poses at a slow speed, storing user data in an encrypted format like a JASON file. This app tracks different diet plans and keeps workout records that are used to maintain health progress. We have also tried different algorithms to detect human workout poses like PostNet and MobileNet. While it was a challenge to develop, our project team successfully created a Future Fitness with AI application for the Android platform capable of tracking, recording, and displaying data relevant to a user's activity, water intake, diet plan, and yoga workout detection. All of the core workout detection and fitness data tracking functionality has been successfully implemented.

REFERENCES

[1] Nur Azlina Mohamed Mokmin, "The Effectiveness of a Personalized Virtual Fitness Trainer in Teaching Physical Education by Applying the Artificial Intelligent Algorithm", International Journal of Human Movement and Sports Sciences, Vol. 8, No. 5, pp. 258 - 264, 2020. DOI: 10.13189/saj.2020.080514.

[2] Android Application, "Cult Fit", [Online] Available : https://www.cult.fit/

[3] Gopinath Krishnan and Prakash Sai Lokachari, "Adoption of Health and Fitness Apps by Smartphone Users:Interactive Qualitative Analysis" IEEE, vol. 59, pp. 2787–2793, Aug. 2019, doi:10.23919/PICMET.2019.8893855.

[4] Goh Kim Nee and Muhammad Syazwan Bin Abu Bakar, "Android-based exercise application" Presented at INET' 96 Annu. Meeting. [Online] Available : https://cutt.ly/iPKT2RO

[5] E. E. Calle, M. J. Thun, J. M. Petrelli, C. Rodriguez, and C. W. Heath Jr, "Body-mass index and mortality in a prospective cohort of US adults," New England Journal of Medicine, vol. 341, pp. 1097-1105, 1999.

[6] PoseNet for iOS, Android and Flutter using TensorFlow Lite. [online] Available:https://blog.tensorflow.org/2018/05/real-time-human-pose-estimation-in.html [12] Firebase , "Data Encryption Algorithm", [Online] Available : https://firebase.google.com/support/privacy

[7] Niharika Pandit, " Kaggle Dataset - Yoga Poses Dataset", [Online] Available :https://www.kaggle.com /niharika41298/yoga-poses-dataset

[8] https://play.google.com/store/apps/details?id=com.btech.fitnesspro

[9] E.C. LaMeaux, "Website - Gaiam", [Online] Available : https://www.gaiam.com/blogs/discover/ how-to-calculate-your-ideal-body-fat-percentage

[10] Survey of, " User Feedback", [Online] Available : https://cutt.ly/YAqyga5

[11] Android Application, "Map My Run", [Online] Available : https://bit.ly/3BMsfK3

[12] Android Application, "Runkeeper-Distance Run Tracker", [Online] Available : https://bit.ly/3LSyUH4

[13] Android Application, "Strava Tracker", [Online] Available : https://bit.ly/36Ayy8d

[14] Android Application, "Yoga Studio: Mind Body", [Online] Available : https://bit.ly/36prvih