

Yoga Posture Detection and Correction System

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Abstract: In past years, Humans are troubled to a wide range of health issues. To recover from this type of issues, yoga has become an important part of life for many people. Yoga can help you improve your body for the better. There are many benefits of yoga, but doing so incorrectly can lead to a dangerous lifestyle. So proper instruction is required. Due to this there is the need of scientific analysis of postures. With proper instructions, a person can reach several benefits from activities while also improving his or her health. Yoga is very popular around the world. Yoga is focusing at development of personality, spirit and the body. There are many ways from which a person can learn a yoga. It can be learnt by attending yoga classes, also with help of videos and images. Most of the people try self-learning by saving their money, but it is hard to find them incorrect part of their yoga poses. With help of this system, the user is under real time supervision. User's pose is compared with the pose in the pre-trained dataset and the difference is calculated between angles of body joints. As a result, Yoga pose is correctly detected and according to the difference in angles the feedback will be provided to the user for improving the pose and doing it correctly. Dataset used for training and testing purpose. This dataset is tested on different Machine learning classification models and achieves an accuracy of 99%.

Keywords: Yoga pose recognition, Machine Learning, Classification, Collection of dataset

I. INTRODUCTION

Yoga is emerged in old India. Yoga is a discipline of Indian Hindu Philosophy. 5000 years ago, India came up with concept of Yoga. The word yoga originated from the word YUJ that means to join. Yoga tells us to focus on your mind by teaching you to stay focused on your specific parts. Yoga maintains that chakra are centre points of thoughts and the physical body, feelings, energy. It also helps to relax and calm the mind and soul. General public has always been attractive to the sports and exercise. This is due to the health benefits. Yoga should be done under proper guidance of an instructor. But in few cases, it is also not affordable for many peoples to take instructor. People use their mobile phones and laptops etc to learn how to do yoga poses and they start doing their own. But the main problem is, they don't know whether it is perfect or not. To solve this problem, many works have been done.

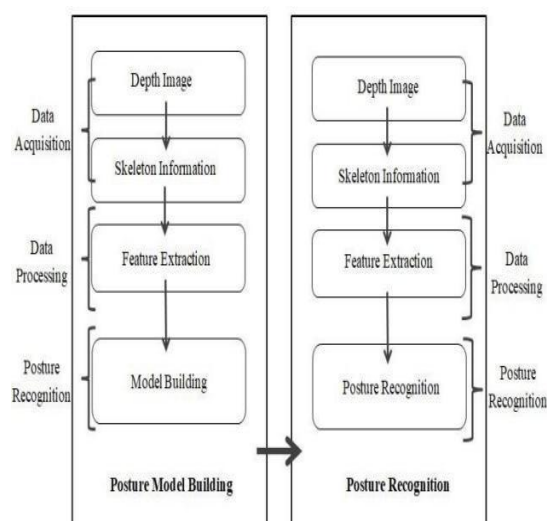
It is very important to do the exercise in correct way. The two Techniques Data science and computer vision have been used to development of AI that works as a trainee. This indicates about accuracy of the performance and also tell the advantages of that pose. Using this, anyone can do yoga with the proper guidance from the software. To use Deep learning and Machine learning modules a dataset has been created which contain some yoga poses like Padmasana, Bhujangasana, Vajrasana, Trikonasana, Vrikshasana, Shavasana etc. Gradient boosting algorithm helps in handling the missing values by studying large datasets and is best in biased error correction. Missing features have been extracted using different algorithms as Ridge classifiers and Logistic Regression. The algorithm makes a skeleton of body by ticking all the joints. Coordinates and angle created from joints can be extracted. RFC is random forest classifier used to extract coordinates and angles formed by joints and then that angle as features for models. RFC is used to identify the class of yoga and gives good classification accuracy.

II. RELATED WORK

Various firms have advanced many tools associated with technology in the exercise field. Zyoga was initiated home workouts during the pandemic up-to 5,000 users. The app is looking to onboard other fitness programmes. According to app analytics platform App Annie, many new fitness and health apps were launched in 2020 to support mental and physical health. A 13 percent increase over 2019. Zenia, the firm calls it "the world's first AI-powered yoga assistant". Wearable X company advanced a wearable product called NADI, which guides us exercise via a mobile app. But yoga pose detection through a mobile phone is difficult task.

There are a number of works that already been done for human pose recognition. Researches have implemented many deep learning as well machine learning techniques for yoga pose detection and correction. Some systems are high-value and are not user friendly. Doubtfully, all learners can be used in the system. Using Y- system Hua-Tsung Chen proposed Yoga training application [3], which identify different poses of user, with contour-based, skeleton-based features and dominant axes points. This system is successful in improving methods of axis generation and feature point detection.

Depth, colour and body tracking can be obtained using Microsoft Kinect device is concluded by many authors [9],[10]. In [4], the authors have come up with Microsoft Kinect device and it records real time key points of the human body. Moreover, it is overpriced compared to a regular cell-phone camera. The device Microsoft Kinect has security concerns. Hence, it is inappropriate for a yoga pose detection system. As the main motto of authors in this system is to recognize the pose, but it fails in mentoring the user to correct the wrong yoga posture. Convolution Neural Network is another technique for human pose detection. In [5][6] authors used Deep-learning model of two different algorithms, in which CNN was used to predict the yoga pose, where as to recognise a pattern between the change of frames LSTM algorithm is used. In [8] author has implemented multi-person pose estimation. Firstly in top down approach, person detector is applied and for every detected person in the frame pose estimation algorithm is used. The number of detected people inside the image is main factor to calculate the speed of this approach. Further-more, bottom-up, vigorous to the number of people. At initial state, from captured image all key points are detected, then clustered together by human instances. Usually this kind of approaches are faster than the previous, as it not only finds key points at once but also human pose estimation for each person is not returned.



III. DATASET COLLECTION

YOGA

POSE NAME



Padmasana



Vajarasana



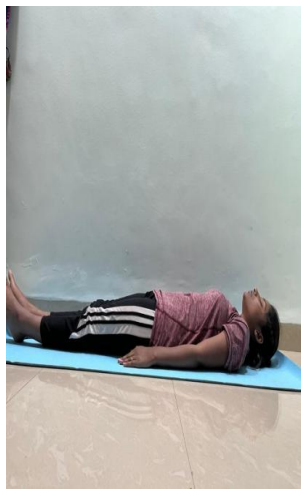
Tikonasana



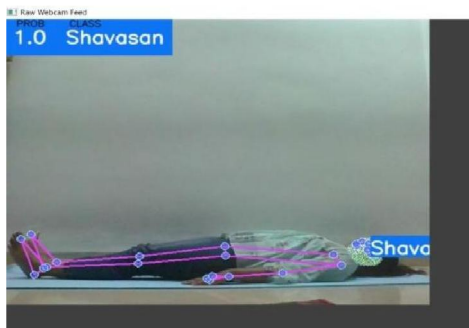
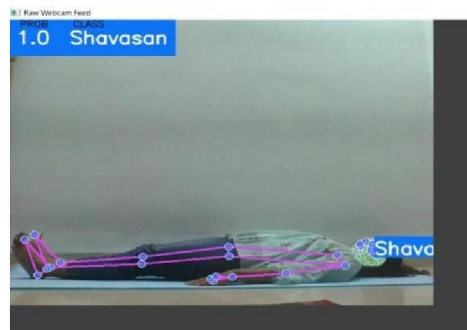
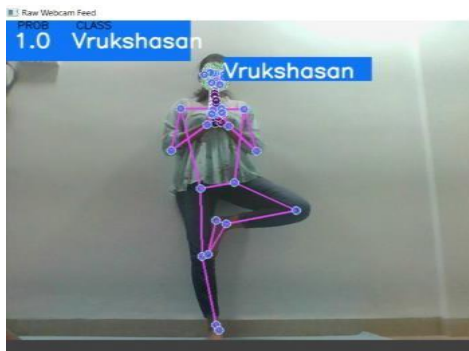
Vrukshasan



Bhujangasan



Shavasana



- 4-5m distance was maintained between camera and expert while capturing the images, through laptop's web camera.
- To identify the yoga poses background was kept clear and white done by the person.
- Front, left, right sides views recording is done for perfection purpose and finally the real time dataset is created
- Recording of each pose is done in a single go.
- And then later, the dataset is kept for training, when the dataset is updated, message will prompt on the console and then used for testing.

Image Dataset

Today, finding an exact and perfect yoga pose dataset file on the sites is a laborious. The terminology related to yoga postures (pose and name) is collected from yoga websites. Sanskrit names of postures are included in help section and annotated manually. Dataset is a collection of bending poses, sleeping poses and balancing poses, in which whole body is used while depicting various yoga poses. There are many variations of hands and leg fold while performing the asanas which leads to main task for algorithm for posture detection. By undertaking the above problem, there are 6 yoga poses are collected in this dataset which was captured using web camera. With high precision and correctness images were captured. 6 yoga poses are trained, while each class comprises around 500 to 1000 images. In all 6000 RGB colour images are stored in csv file.

Classification of yoga poses:

Standing: Yoga pose performed with one or both feet on the ground, and the body is more or less upright. It helps in strengthening and stretching.

Example: Tikonasana, Vrukshasana.

Sitting: Body sitting on ground and promotes relaxation, reduce stress.

Example: Padmasana, Vajarasana.

Reclining: Body lying on the ground, with both legs extended, bend one leg or wrap it under arm which helps to improve spine flexibility, supports digestion.

Example: Shavasana, Bhujangasana.

Wheel: This yoga posture is backbend which provides great flexibility to spine.

Lots of accuracy, attention is required while collecting data manually in such a great volume.

Stepwise dataset collection process:

Asanas were performed in a well-ventilated room with pleasant air, using a mat for good grip.

IV EXPERIMENT RESULTS

Following steps are followed after collection of data

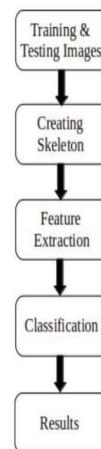


Fig 2: Flowchart of the procedure followed on the dataset.

Feature Extraction

In the next stage, as shown in the stick diagram by using random-forest classifier algorithm, the coordinates of the joints are with drawn. The coordinates that are extracted from the joints are used to calculate various angle differences that is used as features of human body to detect and correctness of the yoga poses and hence various features are extracted accordingly. For calculating the angle between the coordinates of joints the formula is as following

Here is an equation:

$$a = b^2 + c^2 - 2bc \cos A$$

Where, a is distance amongst points p1 and p2

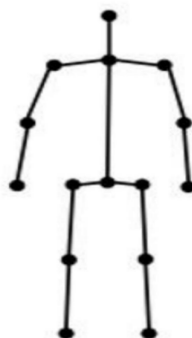
b is distance amongst points p2 and p3

c is distance amongst points p1 and p3 and A is angle made by point p2

Hence, To find the distance amongst two points

$$a = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Where, (x1, y1) are the coordinates of point p1 and (x2, y2) are the coordinates of point p2



Evaluation Matrix

Various methods and strategies were used to detect the accuracy of the machine learning techniques. The frequently used methods are the confusion matrix, classification score and accuracy/loss curve. Model's accuracy is derived using classification score. It is explained as a proportion of the number of predictions to all input samples. These measurements give exact outcomes in a multiclass grouping where the quantity of tests in each class is closely equivalent.

Confusion matrix:

Confusion matrix states exactness of model. There are four notable terms for evaluating the model's performance. True Positive: Predicted numeral and the actual result both of them are 1. True Negative: The digit that is predicted and the real yield both the pair is 0. False Positive: The number that is predicted is equal to one; however, the actual outcome is equal to 0. False Negative: Numeral that is predicted is equal to 0; however, the real yield is equal to 1. Figure below shows a necessary paired grouping of confusion matrix. The digits which are diagonal tell the accurately ordered examples, and along these lines, the matrix diagonal must contain the greatest number generally. If multiclass arrangement occurs then every class tells the one line and grid section

		Actual values	
		Positive (1)	Negative (0)
Predicted values	Positive (1)	TP.	FP
	Negative (0)	FN	TN

V. Conclusion

Since research of Yoga have attracted people from ancient times, as a result many people have gain remarkable results out of it. Studies have been done on yoga posture detection. In this paper, we have come up with real time dataset collection to identify the yoga poses. Then, human pose recognition, along with the human body models and methodologies, is presented. The proposed system is more beneficial and efficient. Easy to handle, improve the best accuracy. Increases the knowledge about yoga poses. The health benefits presented by yoga have attracted many people to adopt it to enable them to lead healthy lifestyles. Because of increasing anxiety in the modern lifestyle, yoga is found as the best solution over it. According to research many people go for self-determined but it is found difficult for them to find mistaken parts of their yoga postures by themselves. In this paper, we have presented yoga posture recognition and correction in the proposed system. First, the system evaluates a learner's Yoga pose by detecting the pose. Second, measuring the difference in body angles between an instructor's and a user's stance. Third, identifying the erroneous part between the learner and the teacher. Lastly categorizing the posture into three levels based on the average angle difference. Hence, according to our knowledge, automated software for recognizing and detecting the poses with the best performance is still not that advanced. Developing this type of module with great performance over many poses considered as future work.

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