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Yoga Posture Detection and Correction System

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Abstract: *Humans, by nature, are sensitive to a wide range of health problems. Yoga can help you improve your body for the better. Although there are many benefits of exercising, doing so incorrectly can lead to a dangerous lifestyle. As a result, proper instruction is required for people who are completing activities on their own. With the right direction, a person can reach several benefits from activities while also improving his or her health. Activities such as meditation and breathing techniques are very important to increase the mental as well as physical well-being of a person by doing asana. These days, Yoga is very popular around the globe. Many people are using self-learning platforms like TV or Videos. Some people also practice it by teaching to one another. However, it is not easy for beginners for finding the inaccurate parts of their Yoga poses by themselves. Hence, a Yoga posture detection and correction system is designed by us. In our paper, first, a Yoga pose assessment method using improved Machine Learning algorithms for pose detection is proposed by us for helping the self-learning of Yoga[19][23]. Using the 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, the yoga pose is correctly detected. Second, according to the difference in angles the feedback will be provided to the user for improving the pose and doing it correctly. This application designed by us is evaluated on various Yoga postured under varying conditions. As a result, there is a guaranteed robustness.*

Keywords: Yoga pose recognition, Machine Learning, pre-trained Dataset.

I. INTRODUCTION

Yoga is a discipline of Indian Hindu Philosophy. It includes spiritual and physical. Yoga uses exercise, meditation and breathing. It helps in happiness and health improvement. 5000 years ago, India came up with concept of Yoga. The word yoga originated from the word YUJ that means to join. The ultimate aim of yoga is to reach ultimate freedom. Yoga tells us to focus on your mind by teaching you to stay focused on your specific parts. Yoga uses breathing controlled as a way to combine spirit, mind and body etc. Yoga can help you to improve your body for the better. Yoga maintains that chakra are center points of thoughts and the physical body, feelings, energy. It also helps to relax and calm the mind and soul.
The two Technics Data science and computer vision have been used to development of AI that works as a trainee. This indicates about accuracy of the performance. Posture recognition is an important module in Yoga Posture Detection For that many machine learning as well as Deep learning use large number of images datasets which been created and trained [1] Gradient boosting algorithm helps in handling the missing values by studying large datasets and is best in biased error correction [21] Missing features have been extracted using different algorithms as Ridge classifiers and Logistic Regression [19][23].The algorithm makes a skeleton of body by ticking all the joints of a body. Angles and coordinates made by the joints can be extracted using algorithm[4][13].RFC algorithm 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[1].

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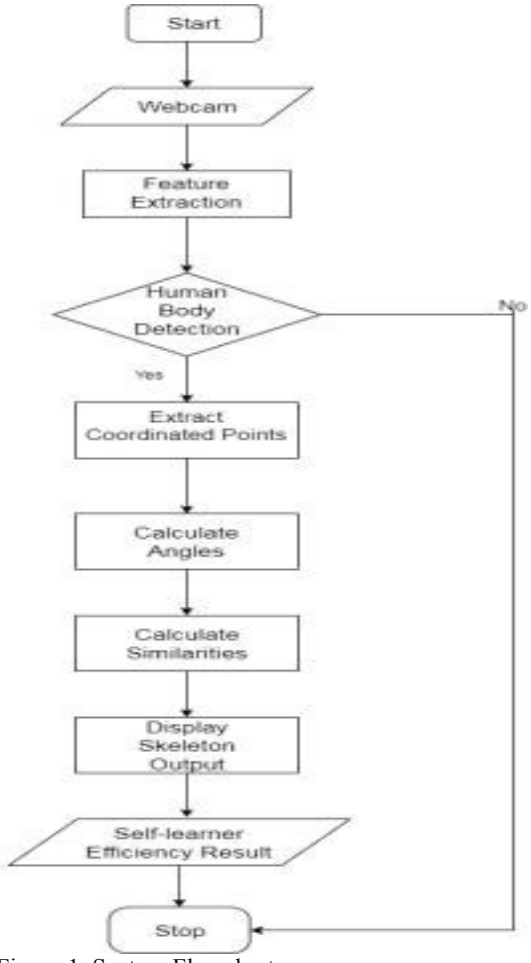

Figure 1. System Flowchart.

II. LITERATURE REVIEW

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 self-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 feature point detection and axis generation.

Depth, colour and body tracking can be obtained using Microsoft Kinect device is concluded by many authors [9],[10].In [4], the authors have came up with Microsoft Kinect device and it records real time key points of the human body. Moreover, it is overpriced compared to a regular cellphone 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 to recognize a yoga pose in which CNN was used to predict the yoga pose, where as to understand 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. Furthermore, 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.

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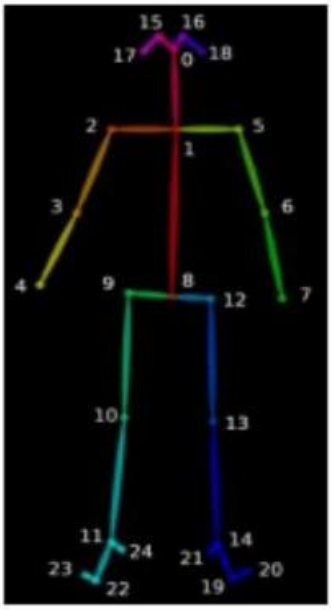

Figure 2 .Key point in human skeleton

Sr. No.	Asana Name	Posture
1	Bhujangasana (Cobra Pose)	
2	Padmasana (Lotus Pose)	
3	Shavasana (Corpse Pose)	
4	Tadasana (Mountain Pose)	
5	Trikonasana (Triangle Pose)	
6	Vrikshasana (Tree Pose)	

Figure 3. Asana and their key points.

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III. PROPOSED SYSTEM

The main idea of this system is to monitor the user performing yoga correctly or incorrectly and hence to correct him/her.

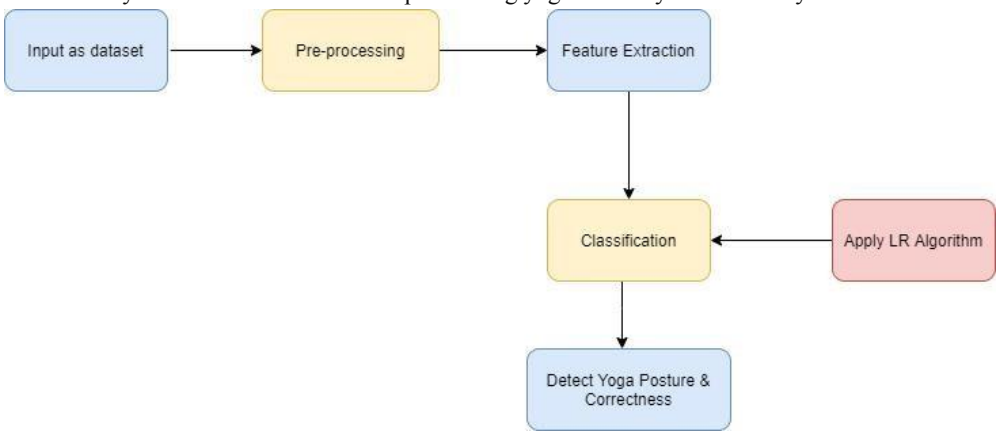

Figure 4. System Architecture.

In this proposed system, the system is able to identify poses performed by the user and also guide the user visually. This process is required to be completed in real-time in order to be more interactive with the user. This system accepts input in the form of textual dataset. While doing data processing using trained dataset we're employing modules like preprocessing, feature extraction, and classification, using different Machine Learning algorithms as Gradient Boosting Classifier, Logistic Regression , Ridge Classifier and Random Forest Classifiers. System accepts the input in the form of textual dataset and then pre-processed the dataset in which the system extracts the features in the extraction section. Then in the classification, we utilise our SVM algorithm for classification and prediction based on the geometric features of yoga dataset and then it detects the yoga pose and corrections.
The Following are some essential algorithms used in this system.

3.1 Gradient Boosting Classifier

Gradient boosting algorithm is mostly used for speed and accuracy. This algorithm can bed with large datasets [21]. Also, it is mostly used in machine learning. There are 2 types of errors in machine learning as Bias error and Variance Error. This algorithm helps us us minimize bias error it is used to fixed base estimator. This is more accurate compared to other models. This algorithm trains faster especially on larger dataset and also helps in handling missing values.
Gradient boosting is a method for its prediction speed, accuracy with large datasets. From Kaygle competitions to machine learning solutions for business, this algorithm produced the best results

A. Advantages

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3.2 Random Forest Classifier

Popular machine learning algorithm Random forest, belongs to the supervised learning technique. In ML, this algorithm is used not only for Classification but also for Regression problems. Concept of ensemble learning is followed by RFC, in which multiple classifiers are combined together to solve a complex problem and performance of the model is improved. As the name indicates, "Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset." Rather than depending on one decision tree, this algorithm takes the prediction from each tree and based on the predominant votes of predictions, and it provides the final conclusion.
The problem of overfitting can be overcome by collecting large number of data points and building trees in the forest tends to produce high accuracy. Following steps are used to describe the working of algorithm:

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- Step-1: From the training set select random K data points.
- Step-2: With the help of selected data points (Subsets) create the decision trees. Step-3: Choose the number N for decision trees that you want to build.
- Step-4: Again repeat Step 1 & 2.
- Step-5: For some new subsets, find the predictions of each decision tree, and assign the new data points to the cluster that contains the majority votes.

A. Advantages

Training time required by RFC is less as compared to other algorithms. Even for the large dataset it provides high accuracy output and runs efficiently. If large proportion of data is missing then to it can maintain accuracy. With high dimensionality large data set is handled. Overfitting problem is prevented using this algorithm and accuracy of system is also maintained.

3.3 Logistic Regression

For classification problems in Machine Learning Logistic Regression algorithm comes into use, this algorithm predicts the analysis and is derived by probability concept. Binary numbers (0,1) are mapped from real numbers with the help of this algorithm. In this survey paper, w sum of features is the input of logistic function, and a certain gesture is likely to be the output. There are many statistical learning methods among them Logistic Regression is used the most and is more popular. The training set in co-ordinates of three axes as x, y and z is given which contains m samples as an input, the regression process calculates the output and obtains the optimal weight vector opt which will minimize the cross-entropy cost function.. It uses a complex cost function also called as sigmoid function; we use sigmoid to map predictions to probabilities.

$$f(x) = \frac{1}{1+e^{-(x)}}$$

A confusion matrix table is used to sketch the performance of a classification model or "classifier" whose true values are known on a set of test data. The exactness in the model is clarified using this. For estimating the model performance, it is classified into four different groups. • True Positive: Bothe the Predicted numeral and the actual result are valued as 1. • True Negative: Bothe the Predicted digit and the real yield are valued as 0. • False Positive: One is the predicted number however, 0 is the actual outcome. • False Negative: Here 0 is the Predicted numeral and 1 is real yield. Figure 3 paired grouping of essential confusion matrix is outlined. Accurately ordered examples are found by the diagonal digits and as we go with these lines, a diagonal matrix is needed for containing the highest number. If a multiclass arrangement is needed then every class should be outlined to a line and grid section as explained by the author in [19][20].

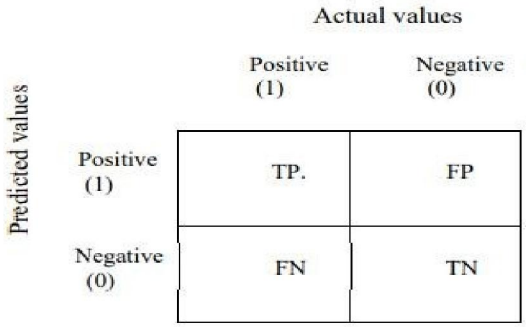

Figure 5. Confusion Matrix

A. Advantages

Logistic regression is easier to implement. It is very easy to interpret, and this algorithm is very efficient to train. No assumptions are made in future space about distributions of classes. It can be easily extended to multiple classes (multinomial regression) and a view of class prediction as naturally predicted by probability. It provides a measure of

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how correct a predictor (coefficient size) is, and also shows its direction of association as positive or negative. LR model is very fast in classifying varying unknown records. It not only provides good accuracy for many simple data sets but also performs well when the dataset is linearly separable.

3.4 Ridge Classifier

The Ridge Classifier, based on Ridge regression method, converts the label data into [-1, 1] and solves the problem with regression method. The highest value in prediction is accepted as a target class and for multiclass data multi-output regression is applied. With l2 penalty RidgeClassifier () works differently as compared to LogisticRegression () . The loss function for RidgeClassifier () is not cross entropy. Ridge () regression model is used by RidgeClassifier () to create a classifier.

IV. CONCLUSION

Yoga attracted people for many year; however, innumerable individuals receive Yoga as a remarkable aspect of their life from the latest decade. Studies have been done on yoga posture detection; though, recognition of posture is yet difficult because of the lack of a real-time dataset. In this paper, we have described a brief analysis of the impact of Yoga on the healthcare system in our daily life. 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 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 being admired throughout the world. Many people go for self-learning but it is 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, the automated software for recognizing and detecting the poses with best performance are still not be developed. Developing such systems with better performance over any number of postures is considered our future work.

V. FUTURE WORK

The presented model right now identifies only 4 yoga postures. There are many yoga poses, and hence implementing a posture estimation model that can be accurate for all the postures is onerous problem. The dataset can be enlarged by adding more yoga as anas carried out by particular person indoor as well as outdoor. Apart from this, we are capable to utilise NLP models which help to communicate software and users and also implement as Google Yoga Pose Identification Model with the help of AI. For this system, we can add portable device for self-learning and real time prediction. This activity shows pose recognition for practical application. The perspective related to this can be implemented for activity recognition in tasks like healthcare, sports etc. Multi-person pose estimation is also a difficult problem and it has a lot of scope for research .As our system detects single person yoga detection in future it can be explored to multi-person pose detection too. There are numerous factors such as lighting, background, overlapping figures etc. also make yoga posture detection challenging. There is still a great scope for research in this incredible field of Pose Estimation. In order to improve the model further, depth camera can be used to detect the Human body/ image. The depth camera will be able to identify multiple bodies, which may solve the problem of multi-person pose estimation. Using the above ideas, we will create an AI Trainer, which will act as a substitute for a trainer. This AI trainer will not only recognize the Yoga pose but will also rectify the incorrect posture (if any)

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