XGBoost analyses of Classification of Yoga

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Abstract: Human body posture analysis is a profound, established computer vision issue that uncovered numerous past difficulties. Breaking down human exercise is advantageous in multiple fields like surveillance, biometrics, and many healthcare applications. Yoga training is recognized to improve flexibility and improvisation of the muscle quality of the breathing process. The yoga postures evaluation is hard to check, so specialists will most likely be unable to benefit from the exercises ultimately. For estimating the compressed workability of concrete, Machine Learning (ML) techniques have demonstrated significant improvement. Nevertheless, the study analyzes the impact of the complexity to decrease on evaluating diverse ML classification techniques. There are 3 distinct ML approaches, including Linear Regression (LR), Support Vector Machine (SVM), and Extreme Gradient Boosting (XGBoost). This work analyses in-depth, diverse poses estimates and key point analytical methodologies and describes several prediction methodologies to classify human posture.

Keywords: Yoga, open pose, machine learning, XGBoost, SVM classification

1. INTRODUCTION:

Pranayama is a traditional India-based concept. It is the healer of suffering and the destructor of anguish, as per the Gita. Yoga is gaining in popularity, and extensive publications on various medicinal implications described cardiac therapy [1], significant health impact [2,3], psychiatric diseases, etc. Yoga may heal several ailments entirely with no need for medications. The workouts enhance overall fitness and assist the physique, psyche, and heart to be clean. It includes numerous exercises. Each one indicates the actual position of the body. People may promote and propagate Yoga while ensuring they do it appropriately—yoga and self-learning methods and training.

Yoga followed an expert instructor's guidance regarding any wrong or improper pose that can cause medical complications, including knee fractures, steep throats, muscle strains, etc. Throughout practice, the Yoga Teacher can adjust the quantifiable metrics. You can only practice Yoga all its own after such good instruction. Nevertheless, individuals seem to be more secure in the residential applications, and virtually all move to an interactive manner. This circumstance requires a yoga practice powered by technology[4,5]. This may be done by using

the mobile app or via online coaching. In each situation, analytical possibilities are immense to make them stronger, more innovative, and more effective.

A model was developing for classifying the postures from the input picture. The categorization methodology is implementing by using the Open Pose image processing approach in XGBoost. The emphasis of the whole study is on the classification of five poses. These postures and healers have been examining key points taken from people with an appropriate position. The key points are working in assessing the yoga posture efficiently.

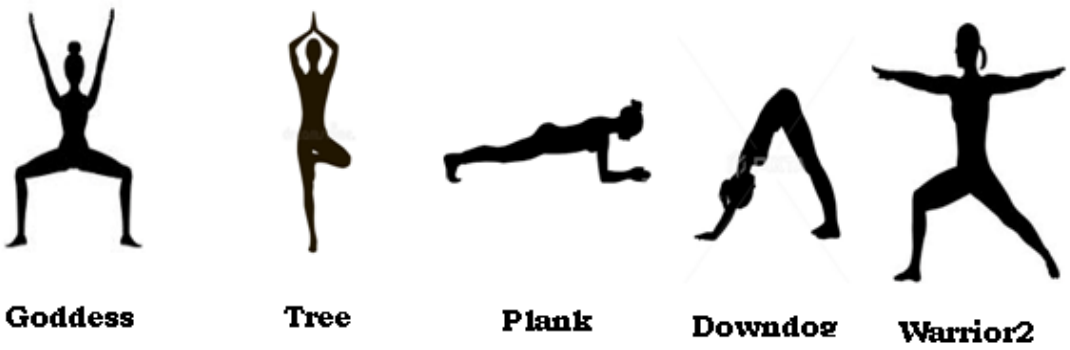

Figure1: The sample images of different postures.

This investigation compares four typical Ml techniques in detail. The nonparametric regression analysis LR and other things seem to establish the relationship between output and input, which is the fundamental regression analysis [6]. SVM is a non-parameter ML technique that can handle non-linear validating issues [7]. XGBoost is a decision tree-based boosted algorithm [8], which allows people to examine the critical results of variables in predictive output.

The remaining sections are explained in detail: Section 2 background of the study. Section 3 discusses the proposed methodology. The execution analysis of Section 4, the concluding remarks in Section 5, and the future enhancement in section 6 and the reference section of Section 7 are describing.

2. RELATED WORKS:

Physical body position assessment was a significant task in image processing, and several performance datasets were describing earlier. In [9], a pose identification approach is applying that uses several features and rules.

Several investigations have been out on the categorization of asanas for evaluation contexts like consciousness [11]. Nevertheless, such tends to integrate asana with a limited set of images or films but not consider many different positions. Individuals are therefore inadequate in simplification and are distant from being intricate in Yoga.

Various works on pose assessment were also establishing. In [12], three factors discussed that might be employed to evaluate the wrist and right forearm: joints inclination, branch direction, and elbow mobility pattern. A posture description language describes [13] to redefine individual body positions and assess full-body motions.

A methodology of yoga evaluation [14] is employing a position identification for the consciousness of Yoga. In order to support the consciousness of Yoga, offer a method of the

yoga evaluation process and explains how to examine yoga postures with the assistance of yoga research by discovering poses.

Applying CNN and LSTM [15], a comprehensive hybrid analysis is given for monitoring yoga in genuine recordings, which takes characteristics from every identifier in the open position of every image accompanied by the LSTM to generate short-term estimations. A mobile assistant yoga application importance of different personal instant messaging purchase concepts.

A smartphone utilization for Yoga Associates was attaining from the numerical simulations [16], and actual fitness experts lead and oversee the clients using video calling to take up Yoga. In order to detect Yoga in fast and accurate films, a thorough hybrid analysis approach recommends integrating CNN and LSTM.

3. METHODOLOGY:

The yoga posture's categorization method primarily identifies the essential features of the yoga pose pictures through the open-position repository. The whole categorization framework of the workout technique and every phase is describing as follows.

3.1. Open Pose:

It's a result of the significant module in high definition. It is capable of concurrently sensing critical parts of individual anatomy, facial and feet.

Send the image over the Convolution layer to retrieve the given source feature vectors during the initial stage.

A non - linear and non-CNN workflow process is the feature vector to produce credibility mapping and values.

The final stage is to use a pessimistic two-party method to produce 2D key points in the image. For every individual, confidence maps and part of the propensity variables are evaluating.

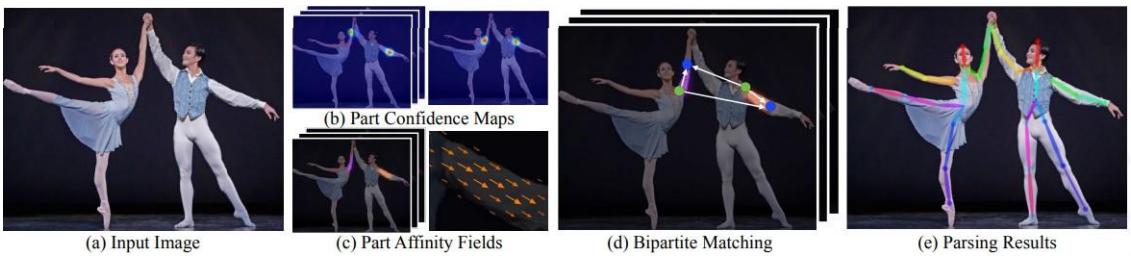

Fig 2. Sample postures of the input image and parsing image

3.1.2. Outcome: The outcome of every image is a JSON file. This file contains several key points. The sequence of these critical moments is adding to the end. Table 1 and Table 2 indicate the appropriate locations of the key points.

Table 1 Table 2

Key point	No
Nose	0
Neck	1
RShoulder	2
RElbow	3
RWrist	4
LShoulder	5
LElbow	6
LWrist	7
MidHip	8
RHip	9
RKnee	10
RAnkle	11
LHip	12

Key point	No
LKnee	13
LAnkle	14
REye	15
LEye	16
REar	17
LEar	18
LBigToe	19
LSmallToe	20
LHeal	21
RBigToe	22
RSmallToe	23
RHeel	24
Background	25

While classifying yoga postures, we created different ML classifiers with key points, including LR, XGBoost, and SVM.

3.2. XGBOOST:

XGBoost is a prominent approach of ML with increasing attention. This decision-making supervised machine learning method employs improved framework gradients, demonstrated to be up-to-date on many issues of computational intelligence. The main principle of this approach of XGBoost is that the technique outcomes are supplying through the summation of several classifications. It simply offers a concurrent boost to the tree, also called GBDT, GBM, which quickly and efficiently addresses numerous data analytics issues.

3.2. **SVM:** A standard SVM using the radial basis function (RBF) kernel on training examples was generating. RBF is a Stochastic RBF and the standard and often used kernel. It offers greater versatility than linear and polynomial-specific kernels. The valuation of the maximal margin objective function is 1 for a single versus decision boundary. SVM characteristics are the essential points that are recording using the Open Pose. The core components are X and Y, which indicates a minimum characteristic. Information is transforming to match the samples.

3.3. LR: The method for categorization issues is among the best commonly used ML algorithms. The exclusive value between 0 and 1 generates using the LR model rather than forecasting 0 or 1. The sigmoid function modifies its performance to provide a correlation coefficient. The LR model employs the objective functions Sigmoid or Logical rather than linear. The LR theory effectively reduces the objective function from 0 to 1. Because linear equations do not represent it, which may have a value larger than 1 or less than 0, that is not conceivable under the LR premise.

3.5. Performance Evaluation Metrics:

We could use various techniques after using ML algorithms to see how successfully they have achieved their goals. Such methods are referring to as measurements of effectiveness. The measures are accurateness, confusion matrix, precision, recall, and f1-score.

3.5.1. Accurateness: Exactness is the proportion of inputs for all kinds of predictions by the method. The total correct mark number (TP + TN) is calculating by the total number of chronic illness data sets (P + N).

3.5.2. Precision: It merely indicates the "number of times data elements are significant." For other terms, approximately percent is genuinely positive observations that a system has forecasted to be favorable.

3.5.3. Confusion Matrix**:** It is one of the most apparent and descriptive measures used to find the correctness of an algorithm for ML methods. It is mainly used in issues with categorization as the outcome may comprise two or more classifications.

3.5.4. F1-Score: The F1 score is a harmonic mean (average) (accuracy, F score, F test, and recall).

4. **Experiments and Results Analysis:**

We have used 80% of the data for training and 20% of the data for testing. For the implementation of the yoga pose classification system, we have used libraries like Numpy and Pandas (for data analysis), Open pose (for key point detection), Scikit Learn(for classification). We have built various ML models for classifying the Yoga poses using key points as features, such as XGBoost, SVM, and LR.

SVM Classification accuracy: 79 %

Confusion Matrix:

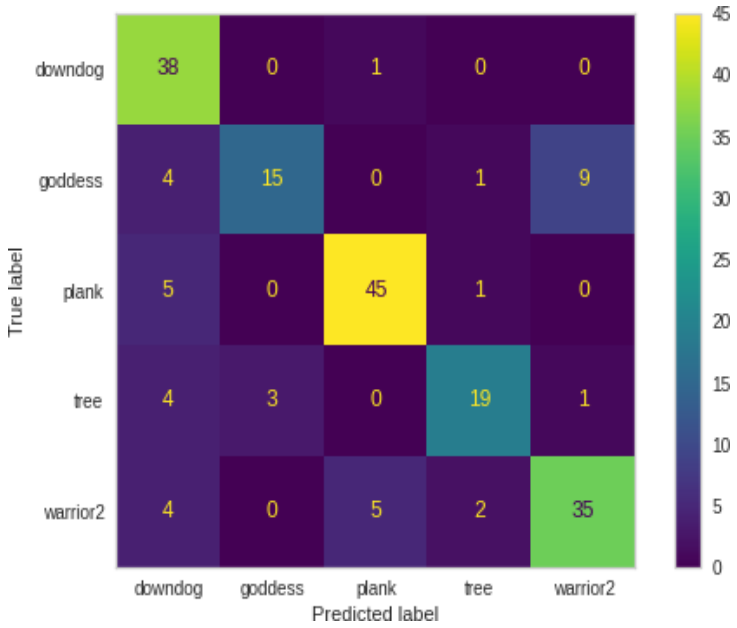

Fig 3: confusion matrix of svm classification of yoga pose

Table 3: Evaluation measures of SVM classification

	precision	recall	f1-score	support
downdog	0.69	0.97	0.81	39
goddess	0.83	0.52	0.64	29
plank	0.88	0.88	0.88	51
tree	0.83	0.70	0.76	27
warrior2	0.78	0.76	0.77	46
accuracy			0.79	192
macro avg	0.80	0.77	0.77	192
weighted avg	0.80	0.79	0.79	192

Logistic Regression:

accuracy: 82%

Confusion Matrix:

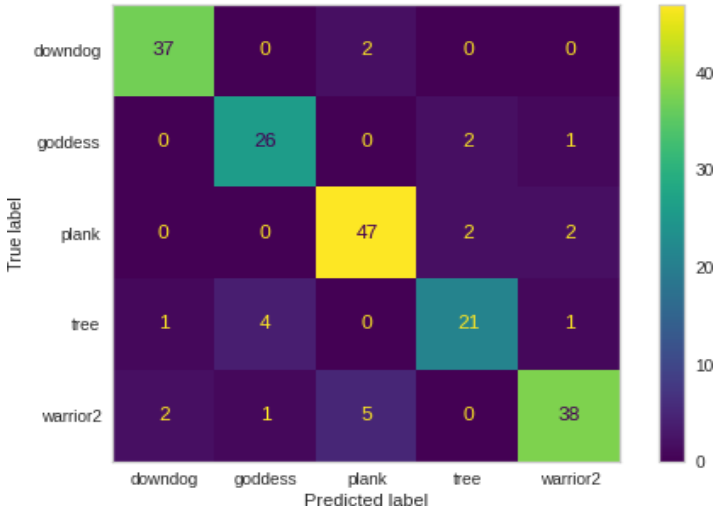

Fig 4: confusion matrix of LR of yoga pose

Table 4: Evaluation measures of LR of yoga pose

	precision	recall	f1-score	support
downdog	0.91	0.74	0.82	39
goddess	0.83	0.86	0.85	29
plank	0.76	0.82	0.79	51
tree	0.73	0.81	0.77	27
warrior2	0.87	0.85	0.86	46
accuracy			0.82	192
macro avg	0.82	0.82	0.82	192
weighted avg	0.82	0.82	0.82	192

XGBoost:

Train accuracy: 88%

Confusion Matrix:

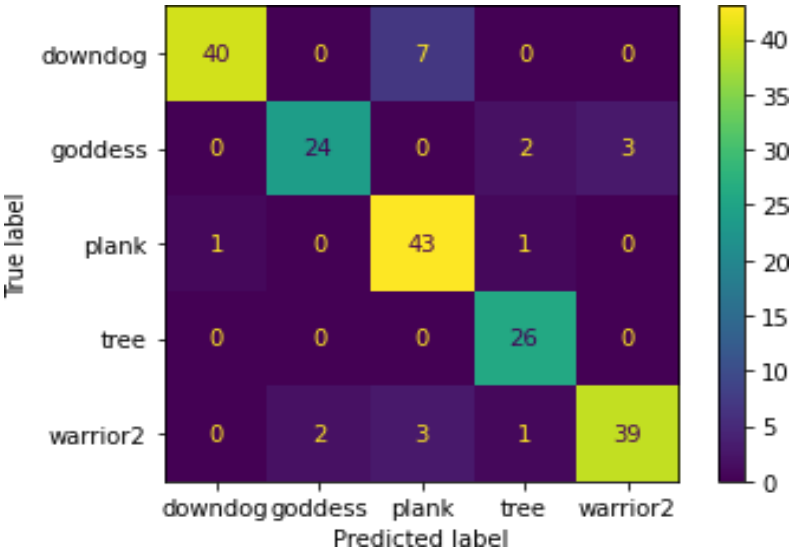

Fig 5: confusion matrix of XGBoost algorithm of yoga pose

Table 5: Evaluation measures of XGBoost algorithm of yoga pose

	precision	recall	f1-score	support
downdog	0.93	0.95	0.94	39
goddess	0.84	0.90	0.87	29
plank	0.87	0.92	0.90	51
tree	0.84	0.78	0.81	27
warrior2	0.90	0.83	0.86	46
accuracy			0.88	192
macro avg	0.88	0.87	0.87	192
weighted avg	0.88	0.88	0.88	192

On comparing different classifiers on test data, the results are showing in table 3. We can observe that the XGBoost model is effective and efficiently outperformed.

Table 6: The accuracy of different ML classification techniques of yoga pose.

Model	**SVM**	**Logistic Regression**	**XGBoost**
Accuracy	79%	82%	88%

5. CONCLUSION:

Yoga and games have interested communities of users for a long time; nevertheless, many users from the last decade acquire Yoga as an essential part of existence. Yoga recognition research was conducting. Yoga is among the most acknowledged ways of living to nourish both physical and mental health. We have suggested an automated image yoga classification model establish a system that may help people practice Yoga with such an online trainer. We have utilized open poses to record the person, recognize key points, and categorize different postures using ML Algorithms. We've studied numerous state-of-the-art classifications such as SVM, LR, and XGBoost. In terms of effectiveness and f1-score, we found XGBoost to be efficient than other classifications. The findings of XGBoost are convincing: the exactness of test data was predicting at 88 percent.

6. FUTURE SCOPE:

The proposed system is only capable of classifying the images. In the future, we can extend this to analyzing the videos to validate the correctness of Yoga poses' movements in real-time. Currently, only five yoga postures are classified. There are numerous yoga poses. Therefore, it is not easy to create modeling of postures estimates, which can succeed for all positions. The collection may also be increasing by utilizing more images, postures indoors and outdoors done by humans.

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