Real-Time Yoga Pose Correction System

Aman Khan Ishan Gupta Madhav Rangaiah
Indraprastha Institute of Information Technology
New Delhi, 110020

Abstract

With yoga one can relieve their stress and maintain a healthy lifestyle. And with limited time, self learning has become an integral part. But without proper supervision, improper postures can lead to damage of muscles and ligaments. Hence, a new system is proposed which will detect practitioners pose and then if needed correct it too.

1. Introduction

The proposed program will take a video of the user's yoga session as input and classify each frame with the most similar (nearest) pose. The output will show which body points / angles are incorrect and display the correct pose for reference. This will assist the user to correct their pose if it's incorrect.

2. Related Works

Chinnaaiah M. C proposes designing a novel Embedded-based Smart Yoga Mat (ESYM) to identify pressure nodes and generate patterns from these nodes using FSR sensors [1]. They developed a pattern identification algorithm and provided real-time pose correction using the Biofeedback mechanism. One major drawback of this approach is that it's not helpful when the person is performing standing yoga asanas. The accuracy depends on the number of pressure sensing points. Also, using a smart yoga mat is not very cost-effective.

Hua-Tsung Chen proposes a system that analyzes the practitioner's posture from both front and side views by extracting the body contour, skeleton, dominant axes, and feature points [3]. Then, based on the domain knowledge of yoga training, visualized instructions for posture rectification are presented to the practitioner. This system is capable of analyzing up to twelve yoga poses. This approach takes two inputs -front view and side view. We aim to provide assistance using a single source camera input.

Ajay Chaudhari proposed a deep learning model that uses convolutional neural networks (CNN) for yoga pose identification and a human joints localization model [2]. The system achieved a classification accuracy of 95%. After obtaining all the information about the user's pose, the system gives feedback in the form of text instructions. This approach extracts human joints in 2D, ignoring the human body shape prior in 3D space. To address this issue, we propose extracting joints in 3D. This approach provides feedback in text format. We aim to deliver pose correction instruction in a visual format using pose transfer methods.

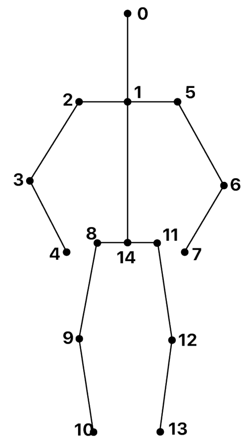


Figure 1. Feature Extraction: Angles of joints

3. Methodology

3.1. Pose Detection

Firstly for pre-processing, we extracted the key points from the images in the dataset. We used the Mediapipe library to extract the 33 body landmarks. Through the 3d coordinates of these landmarks, we extracted 15 body joints, figure 1 (For example, the elbows, shoulders, knees). From these 15 joints we get 14 body lines i.e the line connecting adjacent joints. We calculated the angle between each of these body lines with every other body line, resulting in (14)*(14-1)/2 = 91 body angles. These body angles serve as features for classifying the images.

Now, for each image in our dataframe, we have 91 fea-

(a) Warrior 1 Pose

(b) Tree Pose

(c) Warrior Pose

(d) Natarajasana

(e) Chair Pose

(f) Revolved Triangle Pose

Figure 2. Yoga Pose Classes

tures, and the output class. We trained a stacked ensemble of SVM and KNN classifiers to classify the poses. We are currently classifying yoga poses into 6 different categories figure 2, i.e. Chair Pose, Natarajasana, Warrior 1, Warrior 2 Pose, Tree Pose Revolved Triangle Pose.

3.2. Pose Correction

Once we have classified the the pose in current frame of video with more than 75 percent confidence, we use the Nearest Neighbour method to find the most similar image from our ideal pose dataset. We display the ideal pose image so that the user can refer to it for pose correction.

We'll see the difference of 9 angles, figure3 from the nearest image of that pose. If the difference is significantly high (Say, greater than 10 degree), we'll instruct the user to change their angle at a particular body point. This provides a helpful way of assisting its users during their yoga

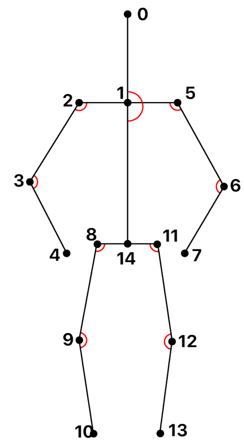


Figure 3. Angles compared for Pose Correction

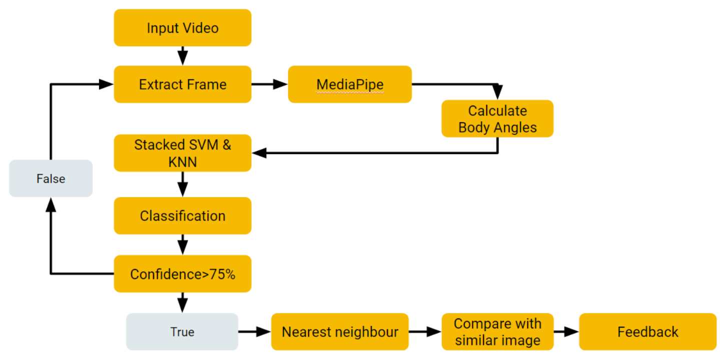


Figure 4. Model Architecture

sessions by providing steps to improve their pose.

4. Architecture

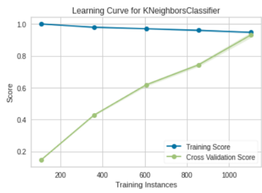
Our models architecture is explained in detail in the flowchart, figure 4.

5. Experiments

5.1. Pose Detection

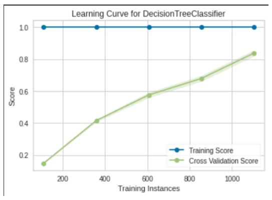
In the proposed yoga pose correction system we divided the dataset into a 75:25 training testing split. For detecting the yoga pose, we passed this processed data with features through several models to see the accuracy for each of the models. We checked each of their learning curves to prevent overfitting/underfitting.

We can see that from figure:2 the MLP Classifier, Random Forest Classifier and Decision Tree Classifier are overfitting (Accuracy of 1 on the training dataset). Among the rest of the classifiers, KNN classifier has the highest accuracy.

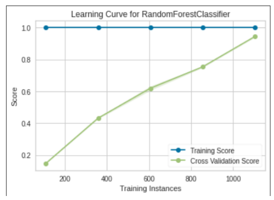


(a) K-Neighbour Classifier

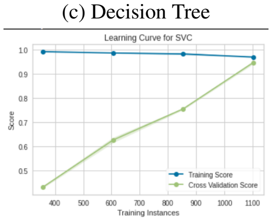
(b) Logistic Regression



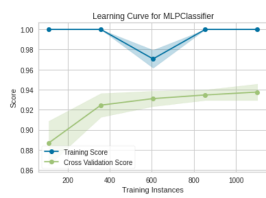
(c) Decision Tree



(d) Random Forest



(e) SVC



(f) MLP Classifier

Figure 5. Learning Curves

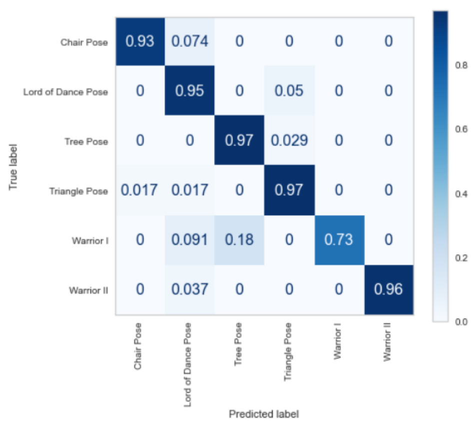


Figure 6. Confusion Matrix

5.2. Pose Correction

After the model classifies it into a correct yoga posture, it will apply kNearest neighbour to find the most similar image, figure 6 that matches with users yoga pose and orientation. Then according to the similar image, the system will provide live feedback on the screen. The model compares the 9 major joint angle mentioned before and provides feedback, figure 5 as to how the user should move his body so it is aligned perfectly to the sample yoga pose image.

Figure 7. Video with suggestions

Figure 8. Similar Figure

6. Conclusion

Our project provides a helpful way of assisting its users during their yoga sessions by providing steps to improve their pose. We can see that the KNN classifier works best on our model and gives an accuracy of 0.93. But, while assisting the users for pose correction, there's still room for improvement. We can take all the body points and angles common and except for where the angles are significantly different from the ideal pose. We can superimpose the deviation of the body part to assist the users better.

References

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