A Review On: Yoga Pose Detection using Deep Learning

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***Abstract*: The angle between body parts is crucial in the variety of asanas that yoga has to offer. If done correctly, yoga is an excellent form of physical exercise that is very good for your health. However, if yoga is practiced incorrectly, it can be harmful to one's health. Therefore, it's crucial to have a trainer when practicing yoga who can show you the proper form for each pose and keep an eye on it. This project includes a non-profit system for strengthening core muscles through yoga-like poses. The proposed technique detects the human position perfectly while performing yoga asanas virtually. This system assists yoga enthusiasts with different yoga poses and validates them for correctness. Integrating computer vision techniques and deep learning techniques, the proposed system analyses the user's human pose then based on the domain knowledge of yoga, the user is directed to correct the pose. Due to high computation requirements and a lack of available datasets, precise pose recognition in yoga is a challenging task. Different feature extraction and preprocessing techniques are applied to the dataset for the accurate detection of the yoga pose, achieving high accuracy just by using machine learning algorithms. The Human Pose Estimation technique, based on computer vision, is used to make the system effective and affordable.**

Keywords: computer vision, feature extraction, machine learning, artificial intelligence, pose estimation

I. INTRODUCTION

Yoga originated in ancient India, and it is a group exercise associated with mental, physical, and spiritual strength. Yoga and sports have been attracting people for so many years but in the last decade, many people are adopting yoga as part of their life. This is due to the health benefits. It is important to do this exercise in the right way, especially in the right posture. It has been observed that sometimes due to a lack of assistance or knowledge people don't know the correct method to do yoga and start doing yoga without any guidance, thus they injure them-self during self-training due to improper posture.

Yoga should be done under the guidance of a trainer, but it is also not affordable for all people. Nowadays people use their mobile phones to learn how to do yoga poses and start doing that but while doing that they don't even know whether the yoga pose they are doing is the right way or not. To overcome these limitations, much work has been done. Computer vision and data science techniques have been used to build AI software that works as a trainer. This software talks about the advantages of that pose. It also talks about the accuracy of the performance. Using this software one can do yoga without the guidance of a trainer. To use machine learning and Deep learning modules many images dataset has been created which contain 10 yoga poses. Features have been extracted using computer vision and the TF-pose Algorithm. This Algorithm draws a skeleton of a human body (shown in figure 4) by marking all the joint of a body and connecting all the joints which give a stick diagram known as the skeleton of a body. Coordinates and the angles made by the joints can be extracted using this algorithm and then used those angles as features for machine learning models. Several machine learning models have been used to calculate the test accuracy of the model. Random Forest classifier gives the best accuracy among all the models.

II. LITERATURE SURVEY

This system detects the difference between the actual and target positions and corrects the user by delivering real-time image output and necessary instructions to correct the identified pose. Human poses estimation is utilized in this research to estimate an individual's Yoga position using computer vision techniques and Open pose (open-source library). In most circumstances, the suggested method retains high accuracy while achieving real-time speed. The proposed model was trained with 90% of the data and tested with 10% of the same with real-time testing, resulting in 94% of accuracy [3].

A novel system is proposed which aim to assist yoga enthusiast with different yoga poses and validate it for correctness. Integrating computer vision techniques, the proposed system analyses the user's human pose then based on the domain knowledge of yoga, the user is guided to correct the pose. Precise recognition of yoga poses is a difficult task because of high computation and lack of availability of datasets. For the accurate detection of the yoga pose, different feature extraction and pre-processing methods are applied to the dataset which results in 97.4% accuracy just by using machine learning algorithms. To make the system efficient and low-cost, Human Pose Estimation technique based on computer vision is used [3].

In this proposed system, the system can identify poses performed by the user and guide the user visually. This process is required to be completed in real-time to be more interactive with the user. In this paper, yoga posture detection was done with a vision-based approach. The Infinity Yoga Tutor application can capture user movements using the mobile camera, which is then streamed at a resolution of 1280 × 720 at 30 frames per second to the detection system. The system consists of two main modules, a pose estimation module that uses Open Pose to identify 25 key points in the human body, using the BODY-25 dataset, and a pose detection module which consists of a Deep Learning model, that uses a time-distributed Convolutional Neural Networks, Long Short-Term Memory and SoftMax regression to analyze and predict user pose or asana using a sequence of frames. This module

was trained to classify 6 different asanas and the selected model which uses Open Pose for pose estimation has an accuracy of 99.91%. Finally, the system notifies the users of their performance visually in the user interface of the Mobile application [3].

III. GOALS AND OBEJECTIVES

- To develop a machine learning and computer vision-based low-cost system that helps to detect and correct yoga pose.
- To improve the accuracy of existing object detection systems using deep learning techniques
- To set up the system in the cloud so that it can be accessed from anywhere at any time.

IV. MOTIVATION

A healthy lifestyle consists of healthy food, healthy physical activities, weight management and stress management etc. It is feasible for people to maintain a healthy life easily by following healthy physical activities. Doing exercises are fallen under these healthy physical activities. There are several types of exercises such as aerobics, strength building, balance training, cardio and yoga. People can do exercises by going to an instructor or a studio or by watching videos on exercises or with their own knowledge. Due to the lack of free time in their daily routine, most people prefer to do exercises on their own with the use of an instruction manual or guides that could be found online. Although exercise has many benefits, improper exercise can result in a dangerous lifestyle. As a result, good guidance is required for people who do exercises on their own.

V. EXTERNAL INTERFACE REQUIREMENTS

- User Interfaces - No user interface needed.
- Hardware Interfaces - No Extra hardware interfaces needed except camera.
- Software Interfaces - Our project is based on ML and computer vision so following libraries are needed – numpy, pandas, scipy, open cv.
- Communications Interfaces - No communication interfaces needed.

VI. NON-FUNCTIONAL REQUIREMENTS

- Performance Requirements- The system should give immediate response when wrong yoga pose detected.
- Safety Requirements- proper light required for higher accuracy.

VII. SOFTWARE REQUIREMENTS

1. Programming Language: Python 3.7 2.
2. Libraries: NumPy, Pandas, SciPy, TensorFlow, Keras
3. Algorithm: CNN

VIII. ADVANTAGES

- Assists in more accurate real-time yoga Practise.
- Correct and fast yoga pose detection using Neural Network.
- Information is output in the form of visual feedback.
- Cloud Deployed - anytime and anywhere access.

IX. System Architecture and Methodology

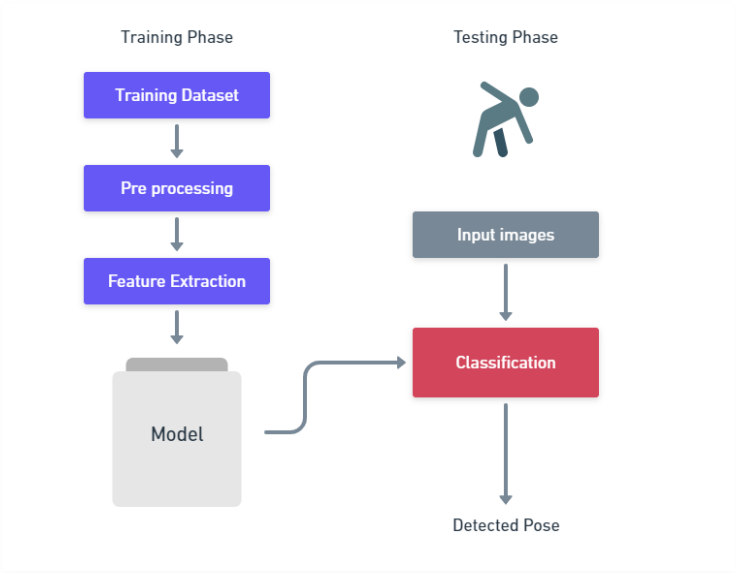

Figure 1 System Architecture

The proposed system can recognize multiple yoga asanas in real-time and from pre-recorded videos too. The First part is data collection, which can be done by either a process for collecting the frames from the videos which are running in parallel with detection or can be from pre-recorded videos. The second part is the pose extraction, a key point detection model used to identify the joint locations using Part Confidence Maps and Part Affinity Fields. The detected key points are passed to our model where CNN identifies the pose, and a predetermined mathematical model is used to identify corrections in the pose.

- We begin the process by capturing the video input of the user performing the yoga poses from the camera. Then we apply Selective Image Extraction to get a clear image of the user and the background disturbances are removed.
- Then a 2-dimensional 15 key body point extraction is applied on the image to procure the key points of the user's body. Then the image is passed through the Yoga Pose Identification CNN classifier, which detects the yoga pose the user is trying to perform.
- If the pose is detected correctly then we compare the estimated key points with the reference key points of the predefined pose, then the error is calculated between the estimated and reference poses, and necessary feedback is given to the user if the error exceeds the threshold limit.

As discussed earlier, we have utilized a convolutional neural network (CNN) to obtain the 15 points on the body with the help of which a skeleton-like figure of the user's pose is created. At the same time, we are creating a target pose that acts as a reference pose for comparing the similarity of the user's pose. The reference pose is the desired yoga pose that the user is trying to perform. The target poses and poses acquired from the key-point detection model will be compared to check the similarity between various angles and joints. This similarity will be used to measure the correctness of the user's pose. The technique to find the incorrectness is to calculate the angles between the joints of the user and based on the domain knowledge of yoga we check if the angles should be within the tolerance level for performing a yoga pose

X. Conclusion

To support a healthy lifestyle for the community able to guide them to practice yoga more accurately in real-time. The methods presented in this study use deep learning to detect incorrect yoga postures and advise the user on how to improve the pose by indicating where the yoga pose is going wrong. Users can select the desired pose for practice and upload recorded videos of their yoga practice poses in the proposed system. The study extracted monitoring activity angles and scaled them to use as a feature. When the user practices yoga, a live video feed is streamed to the server which has multiple modules interconnected to predict and output the asana and the accuracy. A video guide of the predicted pose is shown to the user in real-time helping the user reach the stance properly.

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