



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023



Impact Factor: 8.423

Yoga Pose Correctness Detection

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ABSTRACT: A machine learning project called Yoga Pose Detection and Correction suggests using a Logistic Regression algorithm in conjunction with a human joints localisation model to recognise various yoga positions and spot problems in the user's posture. The system gives the user input on how to change or enhance their stance, and it also has a better methodology for computing scores that can be applied to any pose. To ensure the application's robustness and generalizability, it was tested using various yoga positions in a variety of settings. The suggested technique precisely recognises major human body parts in images and combines them with the overall skeleton to determine the user's posture in real-time. The system demonstrated excellent real-time performance and high accuracy. The grading algorithm for the system has also been updated, and it can be used with any stance, guaranteeing consistency in the feedback given to users for various poses. The suggested algorithm is a trustworthy tool for yoga practitioners of all levels because it is extremely accurate and performs well in real-time.

KEYWORDS: Yoga, MediaPipe, Pose Assessment, Machine Learning, Classification

I. INTRODUCTION

Yoga is a well-liked fitness method that needs perfect form and posture to be efficient and secure. For many practitioners, it might be difficult to maintain perfect form. We put forth a novel approach that makes use of machine learning to help yoga practitioners improve their form and technique in real-time as a solution to this problem.

The suggested method extracts the body joint coordinates from photos or videos of the user executing yoga postures using MediaPipe, a platform for creating multimodal machine learning pipelines. Then, based on the joint coordinates, the pose is classified using Logistic Regression, a type of machine learning algorithm. This enables the system to correctly detect the yoga stance and give the user focused feedback.

In addition to pose recognition, the system offers accurate real-time posture information and feedback to assist users in improving their form. In this procedure, the user's joint coordinates are compared to a predefined set of accurate coordinates for the pose being executed.

The suggested system's accuracy and resilience have been verified through extensive testing on a range of yoga positions and environments. Yoga practitioners of all levels can improve their form and technique, lower their risk of injury, and reach their fitness objectives by using the system's real-time feedback.

Paper is organized as follows. Section II describes various ways of capturing and classifying different poses using various machine learning and deep learning algorithms. After detection of coordinates classification of poses is given in Section III. Section IV presents experimental results showing results. Finally, Section V presents conclusion.

II. RELATED WORK

A wide range of studies on the recognition of human poses, actions, and the health advantages of yoga practise. In the works of Singh et al.[7] and Yu and Yan[2], deep learning and image processing techniques have been applied to recognise human poses, while Bradski and Kaehler's book offers a thorough tutorial on learning OpenCV for image processing[1]. Deep learning approaches are used in other studies, as those by Esmaeili et al. [5] and Wen et al. [6], to recognise and detect postures. While Pitale et al. [10] look at the non-linear characteristics of heart rate variability during various yoga postures, Zhaoyuan provides a review of the health advantages of yoga for men

[9]. Finally, Ren uses the Analytic Hierarchy Process (AHP) to assess the arrangement of yoga movements in colleges and universities [11], and Trejo and Yuan propose an interactive system for recognising yoga poses using a Kinect device [8]. All these references show a broad range of applications for image processing, deep learning, and other methods in the field of human pose and movement detection, as well as the ongoing studies into the health advantages of yoga.

The work in this paper is divided in two stages. 1) Coordinates- Extraction 2) Classification. Coordinate extraction is done using mediapipe; it draws the skeleton on the live video and then collects the pose landmarks from the video. It collects 33 different types of landmarks in which each landmark contains 4 different features namely x , y , z , v where, x , y and z are the 3-dimensional coordinates of the body and v gives the visibility of the body part. The classification of the poses is done using the Logistic Regression algorithm.

III. METHODOLOGY

The Proposed system includes image acquisition, pre-processing, feature extraction, pose determination, correctness calculation, and output. It is intended to detect and correct yoga poses. It seeks to correctly identify yoga postures and offer criticism to enhance or rectify posture.

The system has a clear design that is divided into several phases, starting with image acquisition and ending with the output. The system takes pictures of the user doing yoga poses during the image acquisition phase. To increase the accuracy of the subsequent phases, the obtained images are cleaned up and improved during the pre-processing stage. The feature extraction stage takes the pre-processed image and extracts pertinent characteristics like joint coordinates. A logistic regression model is used in the pose determination stage to determine the yoga position from the retrieved features. The correctness computation stage assesses the pose's accuracy. The output stage shows the user the identified pose and any accompanying feedback.

1. Logistic Regression (LR):

A statistical technique called logistic regression is used to model the likelihood of a binary outcome. The link between the retrieved joint coordinates and the binary result of each yoga posture is modelled in this system. A predicted probability of the posture is represented by an output value between 0 and 1 that is mapped to the input values by the logistic function.

A popular statistical technique for binary classification issues is logistic regression. The one-vs-rest (OvR) method is a well-liked strategy for multi-class classification issues in this suggested system, where a binary classification model is trained for each class. This entails building a different logistic regression model for each stance in the context of identifying yoga poses.

2. MediaPipe:

When extracting features from an image, MediaPipe retrieves the joint coordinates from the source file. The pose is subsequently determined using the retrieved coordinates in the logistic regression model.

A potent tool for creating multimedia pipelines for processing image and video data is called MediaPipe. The joint coordinates from the input image are extracted using MediaPipe in the proposed system. The device has the ability to recognise and track a variety of joints, including the elbows, wrists, knees, and ankles. The logistic regression model that forecasts the yoga pose uses the retrieved joint coordinates as input.

3. Available Algorithm:

Convolutional Neural Networks (CNNs) are yet another algorithm for pose identification that is readily available. They are accurate and reliable because they can immediately learn complicated features from the unprocessed image data. However, they need a lot of labelled data as well as powerful computing power.

For image classification tasks, convolutional neural networks (CNNs) are a well-liked deep learning approach. Since complex features can be directly learned from the raw image data, CNNs are extremely accurate and robust. However, training CNNs requires significant computational power and a lot of labelled data. CNNs may be more accurate than the suggested logistic regression model, but they need a lot more resources and training data.

4. Advantages of Proposed Algorithm:

The suggested approach is effective for real-time pose detection since it provides consistent accuracy and requires little processing power. Additionally, it has a broad range of applications and is adaptable, and the logistic regression model is less of a mystery.



IV. EXPERIMENTAL RESULTS

The Fig. 1 below has two parts in the upper plot the histogram shows the prediction of the class as 0 and 1 the distinct the bars are the better the classification if performed. In the lower plot it shows the ROC curve it is a plot between the True Positive Rate (TPR) and The False Positive Rate (FPR).

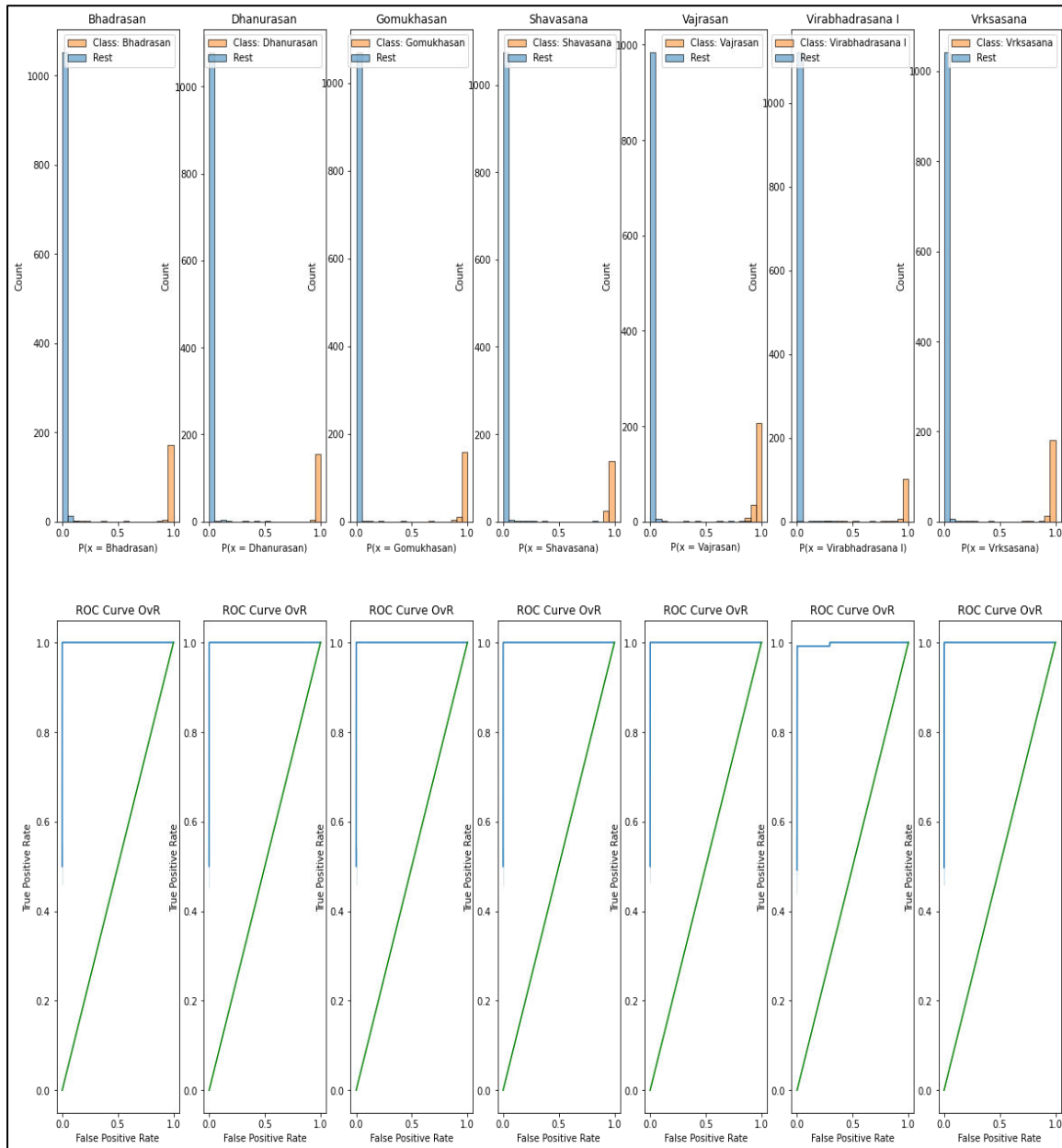


Fig 1: Results

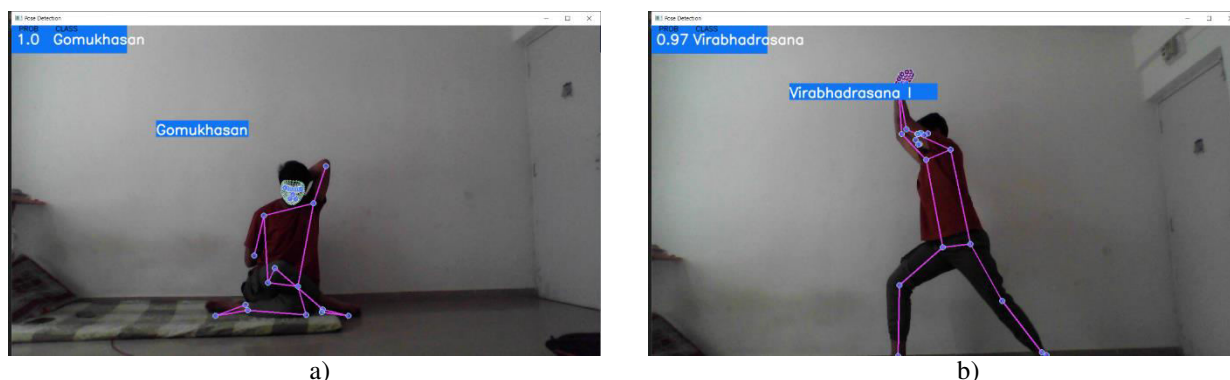


Fig 2: Pose Classification – a) Gomukhasana. b) Virbhadrāsana.

V. CONCLUSION

In conclusion, the suggested system for yoga stance identification and correction combines image processing methods and machine learning algorithms to effectively recognise yoga postures and offer feedback for correcting posture. With the use of MediaPipe, which separates joint coordinates from input images, the system's features are extracted. The link between joint coordinates and binary outcomes for each yoga posture is modelled using the logistic regression model, which is employed for pose determination.

The suggested approach is effective for real-time pose detection since it delivers consistent accuracy and quick calculation time when compared to other available algorithms like Convolutional Neural Networks (CNNs). Its logistic regression approach is also less of a "black box" and easier to grasp, which is crucial for user adoption.

The suggested method has the potential to enhance yoga practise by promoting proper alignment and offering real-time feedback on posture. It might potentially be expanded to incorporate sports medicine and other related disciplines like physical therapy.

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|| Volume 12, Issue 5, May 2023 ||

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SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
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