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Yoga Posture Detection Using Deep Transfer Learning Models

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Machine learning, Deep learning, Artificial Intelligence

ABSTRACT

Yoga is a health-promoting activity that emphasizes mental, spiritual, and physical links. On the other hand, bad postures and yoga practice can lead to health issues like discomfort and sprains of the muscles. Based on a transfer learning approach, we suggest in this study creating an interactive display-based yoga posture coaching system. Eight volunteers were required to execute each of the 14 distinct yoga poses ten times, which were captured by an RGB camera. To avoid overfitting and oversampling the training datasets, data augmentation was used. In order to choose the best model for the yoga coaching system based on assessment criteria, six transfer learning models (TL-VGG16-DA, TL-VGG19-DA, TL-Mobile Net-DA, TL-MobileNetV2-DA, TL-InceptionV3-DA, and TL-DenseNet201-DA) were used for classification tasks. With an overall accuracy of 98.43%, sensitivity of 98.30%, specificity of 99.88%, and Matthews correlation coefficient of 0.9831, the TL-Mobile Net-DA model was ultimately chosen as the best model. The study demonstrated a yoga posture coaching system that could educate users to avoid bad postures by recognizing their movements in real time based on the chosen yoga posture assistance.

1. INTRODUCTION

Yoga is a type of healthy exercise that promotes balance between the physical and mental bodies. It comes from India. It is among the world's oldest sciences and is well-known for its ability to support and preserve both mental and physical well-being as well as spiritual development [1]. Improved flexibility, energy levels, sleep, posture, muscle strength, cardiovascular and circulatory health, athletic performance, and a decrease in chronic pain and injuries are all advantages of yoga practice. For chronic lower back pain, yoga works better than therapeutic exercise and is useful in treating mental health issues [2, 3]. According to the survey participants (89.4%), yoga helps people with depression, headaches, joint pain, and muscle discomfort [4]. Inappropriate yoga poses, however, have been linked to sprains, knee,

wrist, shoulder, neck, and muscle pain. In particular, a 2007 investigation of 34 nations revealed that improper yoga practice typically results in neck injury [5]. Furthermore, a survey of yoga-related injury cases from 2001 to 2014 revealed that sprains (45.03%) and lower limb injuries (21.9%) accounted for 46.6% of injuries brought on by inadequate practice [6]. In a Canadian study (1991–2010), the most frequent injury type was a sprain (23/67, 34%) in the lower extremity (27/67, 42%) [7].In order to prevent such injuries, a number of studies have lately been actively carried out to combine yoga training with artificial intelligence (AI) [8, 9]. Previous research has examined computer-assisted vision of a yoga learning system and eye-free yoga utilizing a Microsoft Kinect as a yoga instructor

[10]. Girija et al. conducted a survey study on posture estimation applied to an Android application, focusing on AI-based yoga posture estimation. They demonstrated a graphical user interface (GUI) for an Android application that used the Pose Net algorithm to compare the model training database with the user video to estimate the posture angle. The determined angle served as the basis for the feedback that was provided. Furthermore, Chinnaaiah et al. suggested real-time activity by integrating help into the yoga mat. Force sensitive resistor (FSR) sensors are used in this method to detect pressure nodes. An algorithm is used to identify patterns in the pressure data, and real-time biofeedback for subject posture correction is given.

Three classes—handguns, individuals, and faces—were used to train the model. We have created a dataset of 5,000 photos that we gathered from various online sources. It features surveillance camera footage of people, close-ups of firearms, and individuals brandishing firearms. Bounding boxes are created around each of the specified classes by YOLOv4. We make use of these boundaries in this investigation. The deterministic method of centers, which measures the distances between bounding boxes; the deterministic method of intersections, which quantifies the intersection areas between bounding boxes; and the deterministic method of distances, which locates the bounding box centers inside other bounding boxes, are the three heuristics we suggest to identify those who carry weapons.

II. LITERATURE SURVEY

Numerous businesses have created a range of technological items related to sports and fitness. The NADI X-Smart Yoga Pants, a wearable gadget by Wearable X, might be used to guide workout form using a smartphone application. Another business, Smart Mat, developed an intelligent yoga mat with a sophisticated sensor to identify the pressure point of stance on the mat and give real-time feedback via a mobile application on whether the user executed the yoga position correctly or wrongly. Yoga Notch developed a wearable gadget that can be worn on the body and gives audible feedback on alignments during at-home yoga sessions. In the modern day, MIRROR—a moveable mirror for use in a home gym that allows workouts to be viewed alongside the user's reflection—is another well-liked exercise assistance tool. Yoga posture detection with a smartphone application is challenging, though, as users must observe closely in order to receive accurate feedback. For addressing whole-body posture, the suggested yoga mat with a pressure sensor proved insufficient.Additionally, the other goods created in this area are not adequate for reflective exercise. Furthermore, MIRROR, the device that included a reflection monitor, still has problems because it just includes a camera that does not detect or correct body position. The cost of using MIRROR, which includes monthly training class fees and product prices, may also be a deterrent for many.

Many research use various methods to classify yoga, including posture estimation using the Open Pose algorithm and posture identification using machine learning (ML) and deep learning (DL) techniques. Using posture estimation with a 3D posture from an RGB camera, Palanimeera et al. demonstrated yoga posture categorization using machine learning for many persons to detect posture in real time. Using a webcam, they examined 12 yoga poses, starting with the sun salutation pose. With a 96% success rate, the approach generated a skeleton, used feature extraction, and classified the sun salutation yoga poses using machine learning models, support vector machines (SVM), k-nearest neighbors (kNN), naïve Bayes, and logistic regression. Using the Open Pose algorithm, a keypoint identification technique, Kumar et al. suggested yoga posture estimate using the public yoga asanas dataset. A video frame containing six yoga poses—cobra, lotus, or seated,

corpse, mountain, triangle, and tree—was used to document the technique. The application of 3D landmark point learning was done by Nagalakshmi et al.

III. PROPOSED SYSTEM

The overview of our proposed system is shown in the below figure.

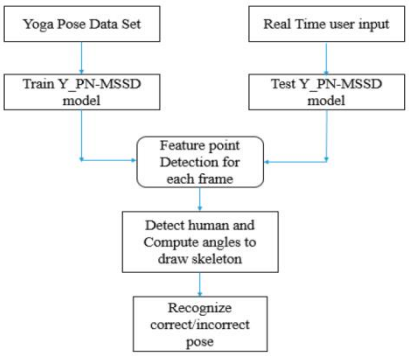

Fig. 1: System Overview

Implementation Modules

Remote User

- In this module, the remote user register to the system, and login to the system valid username, and password. After login successful, he can perform view profile, view added yoga posture , view posture information, and view all posture details.

Detect posture

- In this module to detect the posture and to show that the type of posture.

Start Time

- In this module to detect how much time of taken to each posture.

Change Posture

- In this module can change the posture.

Implementation Algorithms

- **CNN**
- Convolutional neural networks, often known as CNNs or ConvNets, are a type of artificial neuralnetwork (ANN) used most frequently in deep learning for visual imagery analysis.
- Based on the shared-weight architecture of the convolution kernels or filters that slide along input features and produce translation-equivariant responses known as feature maps, CNNs are sometimes referred to as shift invariant.

IV. RESULTS

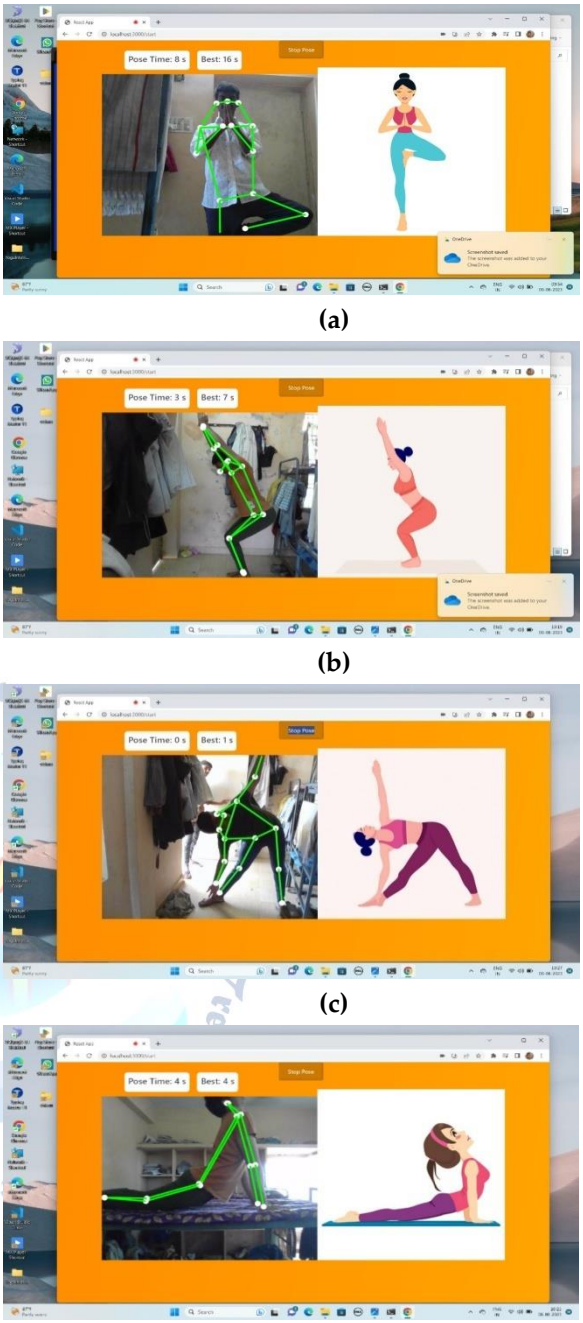

Fig. 2: Yoga Posture

V. CONCLUSION

This study introduced a transfer learning-based yoga self-coaching method. This work began with the collection of the yoga posture dataset using a standard RGB webcam, followed by the application of data augmentation techniques. The Mobile Net model was used to pre-train the transfer learning technique. In the last stage, we developed an AI yoga system that uses a prediction model to make inferences in real time. Finally, by integrating the yoga posture classification approach into our yoga self-coaching system, we were able to

attain a performance accuracy of 98.43%. The yoga self-coaching system was created to identify the poses that adhere to the chosen yoga posture guide, produce the expected outcome, and provide real-time corrections for improper poses. The computed angle of the joints, which is obtained through key point estimation utilizing the Media pipe algorithm, is the basis for identifying bad posture. To sum up, we created a yoga self-coaching system that can instantly verify instruction feedback and forecast yoga posture. We believe that our developed method supports the growing trend of home training from the beginning of COVID-19. Real-time training and recognition of proper yoga posture are provided by the yoga self-coaching system.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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