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SELF-LEARNING YOGA POSE WITH ACCURACY DETECTION USING DEEP LEARNING

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Abstract- ***This paper presents a method for reliably recognising various Yoga asanas using deep learning techniques. A dataset of six Yoga asanas (Bhujangasana, Padmasana, Shavasana, Tadasana, Trikonasana, and Vrikshasana) was constructed using 15 people (ten men and five women) with a standard RGB webcam. A Logistic Regression and long short-term memory (LSTM)-based hybrid deep learning model is suggested. (LSTM) for real-time video yoga detection, using a LR layer extracting features from keypoints of each pose. OpenPose frames are used to generate temporal predictions, which are then followed by LSTM.***

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I INTRODUCTION

Human activity recognition is a well-established computer vision problem that has imposed several challenges over the years [1]. It is the problem of locating keypoints and the posture of a human body from the sensor data. Activity recognition is useful in many domains including biomet rics, video-surveillance, human–computer interaction, assisted living, sports arbitration, in-home health monitor ing, etc. [2–4]. The health status of an individual can be evaluated and predicted with the help of monitoring and recognizing their activities [5]. Yoga posture recognition is a relatively newer application. Yoga is an ancient science that originated in India. According to the Bhagavad Gita, it is the remover of misery and destroyer of pain. Recently, Yoga is getting popular across the globe due to its physical, mental, and spiritual benefits. In 2014, the General Assembly of United Nations has declared 21st June as the 'International Day of Yoga' [6].

II. LITERATURE SURVEY

Over the last decade, Yoga is getting increasing importance in the medical research community, and nu merous literature has been proposed for various medical applications including cardiac rehabilitation [6], positive body image intervention [7, 8], mental illnesses [9], etc. Without the use of medicines, Yoga can completely cure many diseases [10]. Yoga exercises boost physical health as well as help to cleanse the body, mind, and soul [11]. It comprises of many asanas and each of them denotes the static physical postures [12].

Yoga learning and self-instruction systems have the ability to popularize and spread Yoga while ensuring that it is practiced correctly [13, 14]. Computer-assisted self-training systems for sports and exercises can improve the performance of participants and prevent injuries [15]. Many work in the literature have proposed automated and semi-automated systems for analysing the sports and exercise activities such as soccer player ranking [16], swimming [17], tennis strokes [18], badminton [19], rugby [20], basketball [21, 22], vertical high jump [23], hurdles racing [24], etc.

To detect the difference in postures between a practitioner and an expert, Patil et al. [10] have proposed a 'Yoga Tutor' project using speeded up robust features (SURF). However, to compare and describe the postures approximately by using only the contour information is not enough. Luo et al. [25] have proposed Yoga training system with an interface suit comprising 16 inertial measurement units (IMUs) and six tactors, which is obtrusive to the user and can affect the user to perform asana in a natural manner. Wu et al. [26] proposed an image and text based expert system for Yoga; however, they have not analysed the practitioner's posture. Chen et al. [11] introduced Yoga activity recognition using features-based approach to design a self-training system. It uses a Kinect for extracting user's body contour and capturing the body map. A star skeleton was used for rapid skeletonization to obtain a descriptor for the human pose. He work in [12] provides computer-assisted self-training system for posture rectification

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using Kinect. It has taken three postures in consideration, i.e. tree, warrior III, and downward facing dog. However, the overall accuracy is very low at only 82.84%. In [27], a Yoga detection system is proposed for six asanas using Kinect and Ada boost classification with 94.78% accuracy score. However, they are using depth sensor-based camera which generally may not be available to the users. Mohanty et al. [28] have applied image recognition techniques for Indian classical dance and Yoga postures identification from images using convolutional neural network (CNN) and stacked autoencoder (SAE) algorithms. However, they have evaluated their performance on still images only and not on videos.

Chen et al. [15] proposed a Yoga self-training system to assist in rectifying postures while performing Yoga using a Kinect depth camera for 12 different asanas. However, it is using manual feature extraction and making separate models for each asana. Delegate features, like a human skeleton, are compul sory to extract for describing the human postures. There are various skeletonization techniques in the literature, such as thinning and distance transformation. However, these approaches have a high computational cost and are sensi tive to noise [11]. The conventional skeletonization approach has been replaced by deep learning-based methods since the advent of DeepPose by Toshev et al. [29].

DeepPose leads the shift toward deep network-based approaches from classical ones. It uses deep neural network-based regressors to directly regress on coordinates of joints. It anticipates the activity of a person and predicts the location of hidden body parts as well. However, their approach suffers from the localization problem.

III. PROPOSED SYSTEM

Our approach aims to automatically recognize the user's Yoga asanas from real time and recorded videos. The method can be decomposed into four main steps. First, data collection is performed which can either be a real-time process running in parallel with detection or can be pre viously recorded videos. Second, OpenPose is used to identify the joint locations using Part Confidence Maps and Part Affinity Fields followed by bipartite matching and parsing. This is the first step of our pipeline and the OpenPose library is utilized for it. In the case of recorded videos, this step takes place offline, whereas for real-time predictions, it takes place online using input from the camera to supply keypoints to the proposed model. OpenPose is an open source library for multi-person keypoint detection, which detects the human body, hand, and facial keypoints jointly The output corresponding to each frame of a video is obtained in JSON format which contains each body part locations for every person detected in the image. The pose extraction was performed at the default resolution of OpenPose network for optimal performance. The system operated at around 3 FPS at these settings. Our task is to recognize the user's asanas with proper accuracy in real time. First, keypoint features are extracted using OpenPose and recorded the joint location values in the JSON file, and then LR and LSTM models are applied for the prediction of asanas. Due to the combina tion of both, we get the best set of features filtered by LR and long-term data dependencies established using LSTM.

a) SYSTEM ARCHITECTURE

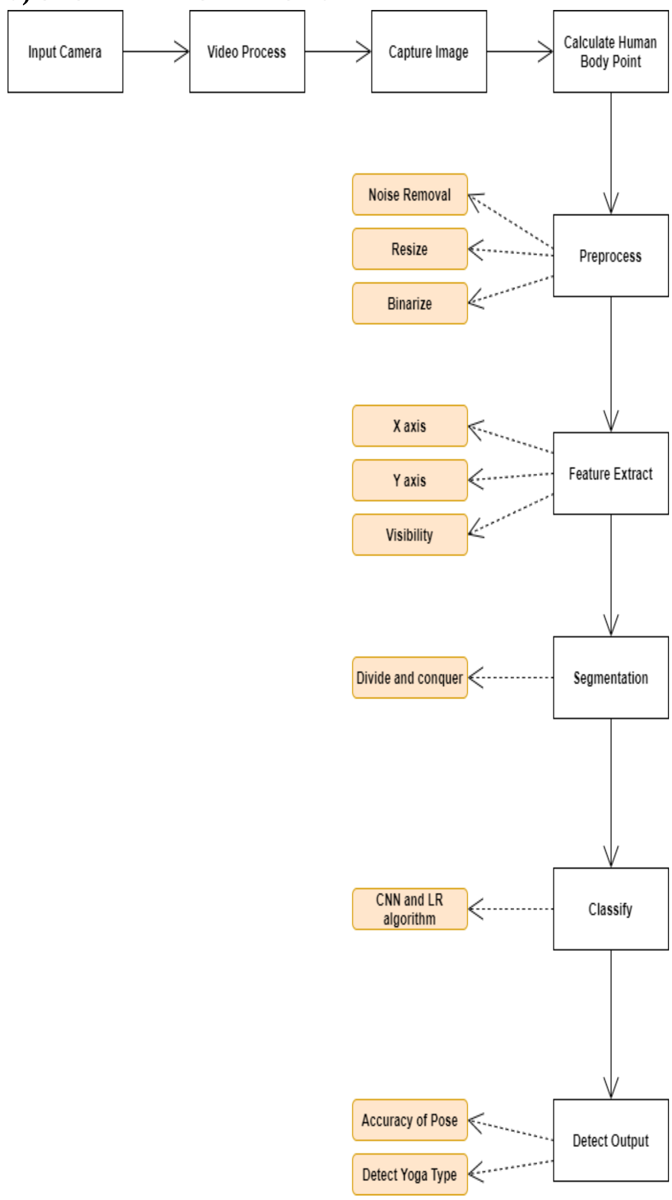

Fig.1 System Architecture

IV. ALGORITHM

Logistic Regression is a Machine Learning algorithm that is used to solve classification problems. It is a predictive analytic approach that is based on the probability notion. A Logistic Regression model is similar to a Linear Regression model, but the Logistic Regression uses a more complex cost function, which can be defined as the 'Sigmoid function' or also known as the 'logistic function' rather than a linear function. Logistic regression, like linear regression, uses an equation as its representation. To forecast an output value, input values (x) are blended linearly using weights or coefficient values (referred to as the Greek capital letter Beta) (y). The output value being modelled is a binary value (0 or 1) rather than a numeric value, which is a fundamental difference from linear regression.

V. CONCLUSION

In this paper, we proposed a Yoga identification system using a traditional RGB camera. The dataset is collected using HD 1080p Logitech webcam for 15 individuals (ten males and five females) and made publicly available. OpenPose is used to capture the user and detect keypoints. The end-to-end deep learning-based framework eliminates the need for making handcrafted features allowing for the addition of new asanas by just retraining the model with new data. We applied the time-distributed LR layer to detect patterns between keypoints in a single frame and the LSTM to memorize the patterns found in the recent frames. Using LSTM for the memory of previous frames and polling for denoising, the results make the system even more robust by minimizing the error due to false keypoint detection

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