YOGGUIDE: DETECTING, RECOGNIZING AND TRACKING YOGA POSES USING VISION TECHNIQUES

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TABLE OF CONTENTS

1. INTRODUCTION:

1.1 OVERVIEW:

Analyzing and understanding human poses estimation is a subject that has been studied extensively in the past two decades. Therefore, this represents interest for many promising applications in different domains, such as security, video games, physical therapy, etc. Problems arise when monitoring human movement is required.[1] One of the challenge in post estimation is yoga. Nowadays, Yoga has become a well-known discipline around the world which is a safe and effective exercise to increase physical activity, especially, in strength, flexibility, and balance, to boost physical and mental well-being. Yoga is a kind of workout for the whole mind-body that makes strengthening with deep breathing, meditation, or relaxation.

Yoga is said as the art of relaxation. From last year, people are dealing with greater pressure and suffering from stress faster than ever before. Even kids are struggling too as they spend too much time on smartphones and tablets.[2]. Disease has sprung up with new dimensions, expressions, manifestations in recent decades. Medical science has put an end to the great plagues of the past, but we are now facing stress-related disorders caused by our inability to adapt to the highly competitive pace of modern life. It is said that psychosomatic conditions such as diabetes, hypertension, obesity, thyroid disorders, migraine, asthma, ulcers, digestive and skin disorders arise from the stresses of body and mind. The leading causes of death in developed countries like cancer and heart disease also rise from tension. Though Modern medical science is trying to tackle these problems in different ways, but they have failed to deliver the good necessary health to man. This is because the real problem is not in the body but comes from the changing ideals of the man, his way of thinking and his feelings. Today international problem is not hunger, poverty, drugs or fear of war. It is tension, hypertension. One who knows how to free from tension and how to control it he will be able to control high blood pressure, heart disease etc. Such stresses and tension accumulate in the various layers of human personality. We concentrate in the physical, intellectual, and emotional systems. Yoga solves tension issues with

a big periscope. In yoga relaxation from tension is one of the main concerns and so the practice of yoga can change the nature of the mind, cure diseases and restore the creative genius.

Yoga has recently become very popular and well known across the globe. Some reports suggest this is because of the benefits it provides. Strength, endurance and flexibility are some of the advantages that in improving them help to maintain the balance of body and spirit at the same time. Actually, Yoga is beneficial for people who are suffering from high blood pressures, heart problems, pains, or full of stresses.[1]

1.2 PROBLEM STATEMENT:

Regular yoga practices can reduce causes of their suffering. As a result, it has become growing massively and increasingly over the past few years around the world. However, not everyone can go out to participate in yoga classes because of inconvenient public transportation systems for the old people, mostly people can't go due to time issue. Therefore, it is important for them to practice Yoga at homes by themselves. However, it is not easy for novice Yoga people, particularly seniors, to find the incorrect parts of their Yoga poses by themselves. Usually people doing yoga poses at home without instructor either do in incorrect manner or overdo the poses which lead to acute pain and long-standing chronic problems.

We know yoga is a great form of exercise and has benefits like improving flexibility and strength, and reducing stress and anxiety but if performed incorrectly, it can also cause harm to your health some serious health problem which can occur by doing wrong yoga possess are:

1. Backache
2. Ankle Sprain
3. Stiff neck, sprain and pain in the neck
4. Muscle Pulls

1.3 PROJECT OBJECTIVES:

The objectives of our project are:

- To provide an application for correct yoga poses
- To work on correct pose estimation using real time image capturing

1.4 PROJECT SCOPE:

Our project will cover 3 main yoga poses which are:

1.4.1 GODDESS SQUAT: Subject sits by bending its knees so that the arms and elbows become parallel to the head and each leg stays in parallel position as shown in Fig. 1(a)

Fig. 1(a)

1.4.2 WARRIOR: Subject spreads its left leg as much as possible while the right leg is vertical to the ground and spreads two hand so that they fall in a line as shown in Fig. 1(b)

Fig. 1(b)

1.4.3 REVERSE WARRIOR: In this pose, Subject spreads it right leg as much as possible while the left leg is vertical to the ground and keeps the right hand on right knee and the left hand is placed parallel to the head and vertical to the ground as shown in Fig. 1(c)

1.5 PROJECT OUTCOME:

The output of this project will be a system through which user can do yoga exercises without any instructor with correct posture recommendation.

2. BACKGROUND/LITERATURE REVIEW:

Pose recognition methods focus on detecting human figures in images and video, with the goal that one could decide, for instance, where somebody's elbow appears in a picture. There are a number of works that have been proposed for human posture recognition **[3] - [10]**. Gochoo et al. [3] developed a system for IoT-based privacy-preserving and device-free yoga postures recognition method using a deep convolutional neural networks (DCNNs) and a low-resolution infrared sensor-based wireless sensor network (WSN). They collected a total of 93,200 posture images and worked with 18 candidates to represent yoga poses. Similarly, an approach to accurately recognize various Yoga asanas using deep learning algorithms by Yadav et al. [4] has been presented in this work using convolutional neural network (CNN) and long short-term memory (LSTM) for Yoga recognition on real-time videos and a total of 6 yoga asanas were recorded that achieved a test accuracy between 98% to 99%.

Trejo and Yuan [6] proposes a technique to perceive 6 regular Yoga poses by a Kinect sensor. Initially, the Adaboost algorithm is used to build the database for poses recognition, which is provided in the tools of Kinect for windows SDK v2.0. This system also provides the

user with command voices so user can easily interact with the system for purposes such as changing yoga poses and receiving instruction for a particular pose. Likewise, Islam et al. [8] have given out a system which can monitor human body parts movement of different yoga poses which aids the user to practice yoga. It has used Microsoft Kinect to detect different joint points of human body in real time and from those joint points accuracies is calculated on various angles of a certain yoga pose for a user. Three types of poses are detected and accuracy above 97% is calculated.

Author/ Paper/Year	**Work**	**Dataset**	**Technique**	**Number of poses/ gestures**	**Accuracy**
Gochoo et al., 2019 **[3]**	This paper proposes an IoT-based privacy-preserving yoga posture recognition system.	In total, 93,200 posture images are employed.	Deep Convolutional Neural Network (DCNN).	Nearly 26 yoga postures from 18 candidates were collected.	Results had 98%-99% accuracy, respectively.
Yadav et al., 2019 **[4]**	An approach to accurately recognize various Yoga asanas using deep learning algorithms has been presented in this work.	A dataset of six Yoga asanas has been created using 15 individuals.	Convolutional neural network (CNN) and long short-term memory (LSTM).	A total of 6 Yoga asanas were recorded in real-time.	The system achieves a test accuracy of around 99.04% to 99.38% accuracy.

Maddala et al., 2019 **[5]**	A system developed for recognition of yoga asanas using Joint Angular Displacement Maps (JADM).	Video sequence of yoga.	Single stream deep CNN model.	20 yoga poses.	Accuracy of around 90%.
Trejo and Yuan, 2018 **[6]**	Microsoft Kinect device is used to sense the posture and give enhancement instructions.	Dataset was collected by Kinect sensor.	Kinect sensor is used to perceive yoga poses.	Six common asana yoga poses are used for this study.	Final database showed above 94.78% in terms of accuracy.
Chen et al., 2018 **[7]**	This system integrates computer vision techniques and analyzes body contour, skeleton, dominant axes, and feature points.	Images, videos captured in real time.	C++ implementation in OpenCV.	The proposed system can analyze up to 12 poses.	Accuracy between 92% and 99% for front and side view.
Islam et al., 2017 **[8]**	System can monitor human body parts movement of different yoga poses which aids the user to practice	Video data is captured by using Kinect device.	Microsoft Kinect used to gather joint point information.	Three types of poses: Goddess Squat, Warrior, Reverse Warrior.	The accuracy is above 97% for every angle between different body parts.

	yoga.				
Jiang et al., 2017 **[9]**	This paper proposes a novel multi-layered gesture recognition method with Kinect.	Kinect with ChaLearn dataset.	Hand glove motion to record images.	More than 50, 000 gesture sequences were recorded with Kinect.	The proposed method achieves high recognition accuracy 88%.
Liu et al., 2017 **[10]**	A system which uses hand gesture recognition using kinetic.	Dataset contains 1200 different data samples.	Radial Basis Function (RBF) neural network.	10 different gestures.	The correct classification rates are reported to be 95.83% and 97.25%, respectively.

Madala et al. [5] has given a system developed for recognition of yoga asanas using Joint Angular Displacement Maps (JADM). To improve the recognition accuracy with reduced training times, JADMs are tested with a single-stream deep CNN model. In total around 20 yoga poses are tested on video sequenced data. Accuracy turned out to be above than 90%. Chen et al. [7] in the paper proposed a yoga self-training system, which aims at instructing the practitioner to perform yoga poses correctly, assisting in rectifying poor postures, and preventing injury.

Integrating computer vision techniques, the proposed system analyzes the practitioner's posture from both front and side views by extracting the body contour, skeleton, dominant axes,

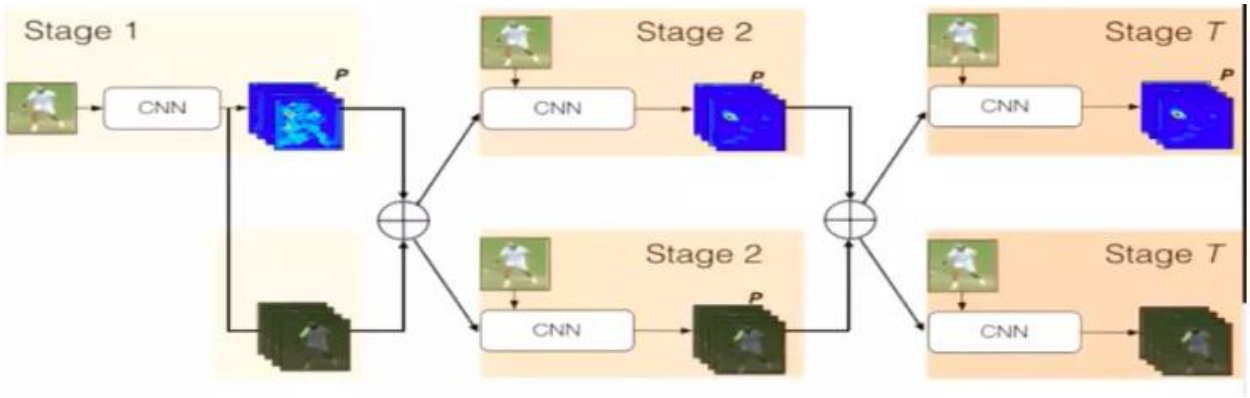
and feature points. Then, based on the domain knowledge of yoga training, visualized instructions for posture rectification are presented so that the practitioner can easily understand how to adjust his/her posture using OpenCV with C++. The proposed system can analyze up to 12 poses with the accuracy being between 92% and 99%.

Jiang et al. [9] categorized data gatherings into two groups wearable sensor-based methods and optical camera-based methods. Kinect recorded ChaLearn Gesture Dataset comprising more than 50, 000 gesture sequences and used hand glove motion to record gestures. The proposed method achieves high recognition accuracy 88%. Similarly, Liu et al. [10] used RBF neural network to approximate hand motion dynamics underlying motion patterns of different gestures. Dataset contains 1200 different data samples and 10 different gestures. The correct classification rates are reported to be 95.83% and 97.25%, respectively.

3. PROJECT METHODOLOGY:

OpenPose is a CNN (Convolutional Neural Network) based approach which handles pose estimation using multi-stage classifier where each stage improves the results of the previous one. First stage takes the input image and predicts the possible location of each key point (in our case joints) with a confidence score called **confidence mapping**.

Input Image (a) Stage 1



In System Development Life Cycle (SDLC), we are going to use iterative model in which is best thought of as a cyclical process. After an initial planning phase, a small handful of stages are repeated over and over, with each completion of the cycle incrementally improving and iterating on the software. Therefore, enhancements in iterative model can quickly be recognized and implemented throughout each iteration.

3.1 DATASET: Dataset will be created by the students themselves which is why more than one month is taken by the students for data collection. It will be in the form of images and videos

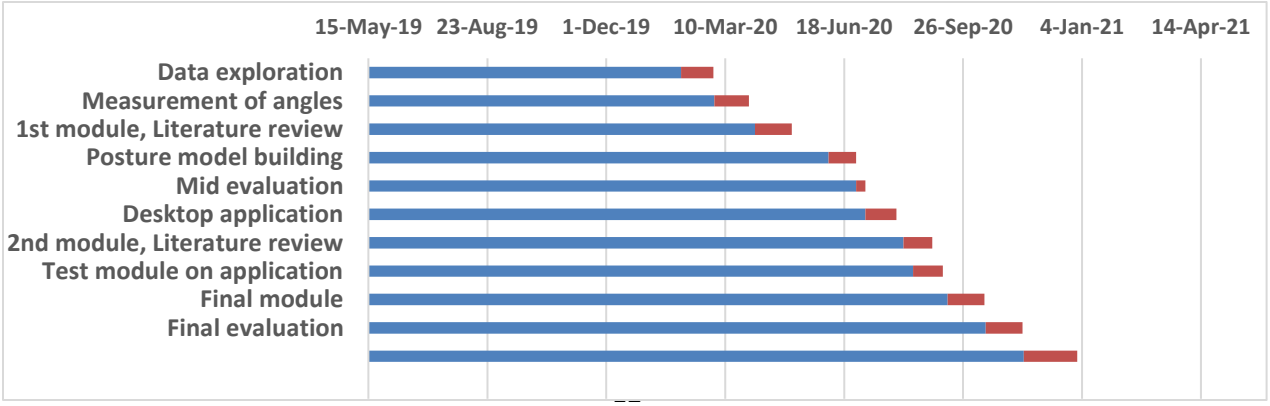
4. PROJECT SCHEDULE:

4.1 KEY MILESTONES:

S. No	Elapsed time since start of the project	Milestone	Deliverable
1	February (Research)	Read scientific papers Gather data insights Decide on methodology	Detailed project execution plan
2	March (Data exploration)	Slice data in different ways Gather datasets	Report with the results
3	April (Measurement of angles)	Body joints point detection	No deliverables

		Report writing	
4	May (1st module, Literature review)	Skeleton information Data processing Related research paper writing	Validate dataset to the supervisor Literature review writing
5	June (Posture Model Building)	Model building	Presentation and report submission Mid evaluation
MID EVALUATION			
6	July, August (Desktop application)	Application designing and development Report writing	Report with the design and front-end
7	September (2nd module, Literature review)	Application processing Related research paper writing	Report the application Literature review writing
9	October (Test the model on application)	Testing application Report writing	Test report First draft of report
10	November (Final model)	Maintenance of application	Final report
FINAL EVALUATION			

4.2 GANTT CHART:



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