

"Surya Namaskar pose recognition and correction for smart healthcare"

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ABSTRACT

Surya namaskar is considered a part of modern-day yogic practices though it was neither considered an asana nor a part of traditional Yoga. Practicing Surya namaskar before beginning routine activities vitalizes the practitioner and gives a completely energized day. Starting from the Raja of Aundh who first introduced surya namaskar, there is a line of eminent people who popularized this dynamic group of asanas including T Krishnamacharya, Swami Sivananda, Swami Satyananda from Bihar school of Yoga, so on and so forth. Their contributions resulted in this excellent series of Asanas being introduced to the practitioners. Such a miraculous group of postures also involves dynamic breathing patterns at each posture and gives a form of complete practice involving asanas and pranayama. There are a total of 12 postures in Surya namaskar practice and 24 steps in one round. This is in the form of salutation to the "Sun" along with chanting the twelve names of the sun god. In this review, we accentuate the importance of Surya namaskar highlighting its effects on physical, psychological and physiological aspects of the body based on published research. In addition, the usefulness of Surya namaskar as one complete sadhana for the whole body is emphasized.

Keywords: Computer Vision, Smart Health Care Integration, Real-Time Feedback, Machine Learning.

I. INTRODUCTION

Every day for all living beings begins with the sunrise for there is no life on earth without the sun. The Sun is indeed worshipped as a god in various cultures by the name of Mithras in Persians, Apollo in Greeks, Osiris in Egyptians, and Surya in the vedic period of India and so on. In Ramayana, Sage Agasthya advised Lord Sri Rama to worship the sun god by chanting Aditya Hridayam to achieve victory in his encounter with the demon king Ravana. These verses depict the various forms and names of the sun god, praising his glory and his 12 forms (signifying the shape of 12 months of a year) in the Yuddha Kanda of Ramayana. The sun is considered as the Pratyaksha swarupa (the ultimate power visible to the eye), which represents truth, a manifestation of knowledge, and the giver of intellect & prosperity. The sanctity of the sun god is explained in a chapter containing 132 verses named 'Surya namaskar' in Taittiriya Aranyaka under Krishna Yajur Veda. This is being chanted as a ritual practice among South Indians along with the performance of namaskara (salutation) at the end of each verse. In present times Suryanamaskar is both a physical as well as a spiritual practice. It was inserted into yogic practices owing to its immense potential in maintaining the practitioner's physical and mental health which is the basic requirement for higher yogic practices. We reviewed this spectacular practice of various schools through standard textbooks published by the respective schools and highlight its importance in disease management through research articles indexed in PubMed/Scopus/web of science.



Fig.No:1

II. BACKGROUND STUDY

Nowadays, yoga has gained worldwide attention because of increasing levels of stress in the modern way of life, and there are many ways or resources to learn yoga. The word yoga means a deep connection between the mind and body. Today there is substantial Medical and scientific evidence to show that the very fundamentals of the activity of our brain, our chemistry even our genetic content can be changed by practicing different systems of yoga. Suryanamaskar, also known as salute to the sun, is a yoga practice that combines eight different forms and 12 asanas(4 asana get repeated) devoted to the Hindu Sun God, Surya. Suryanamaskar offers a number of health benefits such as strengthening muscles and helping to control blood sugar levels. Here the Mediapipe Library is used to analyze Surya namaskar situations. Standing is detected in real time with advanced software, as one performs Surya namaskar in front of the camera. The class divider identifies the form as one of the following: Pranamasana, Hasta Padasana, Hasta Uttanasana, Ashwa - Sanchalan asana, Ashtanga Namaskar, Dandasana, or Bhujangasana and Svanasana. Deep learning-based techniques(CNN) are used to develop this model with model accuracy of 98.68 percent and an accuracy score of 0.75 to detect correct yoga (Surya Namaskar) posture. With this method, the users can practice the desired pose and can check if the pose that the person is doing is correct or not. It will help in doing all the different poses of surya namaskar correctly and increase the efficiency of the yoga practitioner. This paper describes the whole framework which is to be implemented in the model.

III. LITERATURE SURVEY

1. A Survey on Yogic Posture Recognition:

Yoga has been a great form of physical activity and one of the promising applications in personal health care. Several studies prove that yoga is used as one of the physical treatments for cancer, musculoskeletal disorder, depression, Parkinson's disease, and respiratory heart diseases. In yoga, the body should be mechanically aligned with some effort on the muscles, ligaments, and joints for optimal posture. Postural-based yoga increases flexibility, energy, overall brain activity and reduces stress, blood pressure, and back pain. Body Postural Alignment is a very important aspect while performing yogic asanas. Many yogic asanas including

uttanasana, kurmasana, ustrasana, and dhanurasana, require bending forward or backward, and if the asanas are performed incorrectly, strain in the joints, ligaments, and backbone can result, which can cause problems with the hip joints. Hence it is vital to monitor the correct yoga poses while performing different asanas. Yoga posture prediction and automatic movement analysis are now possible because of advancements in computer vision algorithms and sensors. This research investigates a thorough analysis of yoga posture identification systems using computer vision, machine learning, and deep learning techniques.

2. Human Action Recognition for Pose-based Attention: Methods on the Framework of Image Processing and Deep Learning:

In order to solve these thorny problems, three algorithms are designed and implemented in this paper. Based on convolutional neural networks (CNN), Two Stream CNN, CNN+LSTM, and 3D CNN are harnessed to identify human actions in videos. This paper presents an overview of some approaches of Human action recognition (HAR) for pose-based attention. The paper focus is on algorithms that use video processing on a given dataset. A series of videos is given for the layout, where an individual executes an event in each video. The action performed on that particular video will be the label of a video. Each algorithm is explicated and analyzed on details. HMDB-51 dataset is applied to test these algorithms and gain the best results.

3. Deep Learning for Human Action Recognition Modern:

A list of the best HAR datasets is given in order to show the variety of the available videos online. Local and Global feature extraction are reviewed. The aim of this project is to develop a model for human actions such as running, jogging, walk-ing, clapping, handwaving and boxing. Experimental results showcase that the three methods have effectively identified human actions given a video, the best algorithm thus is selected. Also some of the most common Deep Learning methods are studied: Recurrent Neural Network (RNN), Convolutional Neural Network (CNN) and Generative Adversarial Network (GAN). All of the methods are directed to recognise the pose and the focus of the person in a recording. A series of videos is given for the layout, where an individual executes an event in each video.

4. Surya Namaskar Pose Identification and Estimation Using No Code Computer Vision:

Suryanamaskar, or Salute to the Sun, is a sequence of yoga asanas that originated from the old Indian yogic traditions. It is a sequence of twelve asanas: Pranamasana, Hastauttanasana, Hasta Padasana, Ashwa Sanchalanasana, Dandasana, Ashtanga Namaskara, Bhujangasana, Dandasana, Ashwa Sanchalanasana, Hasta Padasana, Hastauttanasana, and Pranamasana. Five pose pairs are identical: first and twelfth, second and eleventh, third and tenth, fourth and ninth, and fifth and eighth. The sequence of asanas is designed in a way that each asana complements its previous one. Suryanamaskar has been known to reduce blood pressure, resting pulse rate, and improve cardio-vascular rates in individuals. The current research examines a Suryanamaskar pose in isolation and aims to identify the pose as one of the seven different poses defined earlier.

5. A Deep Learning-Based Approach to Detect Correct Suryanamaskara Pose:

We present a technique to analyse Suryanamaskar poses using key point estimation and statistical analysis. The proposed approach uses a trained model based on COCO key point detection dataset and uses it to determine keypoints in yoga poses. Our work uses the key point detection to suggest a self yoga correction system. A novel dataset, Surya-yoga, containing 10000 Suryanamaskara poses has been generated and made publicly available. The model presented in this paper performed better on the COCO dataset and combined COCO and Surya-yoga dataset when tested using part affinity fields. The work also presents an analytical method of distinguishing different Suryanamaskar poses alongside deep learning methods.

IV. METHODOLOGY

1. Data Collection and Annotation:

A diverse dataset of Surya Namaskar sequences performed by individuals of varying skill levels is collected. Each pose in the sequence is meticulously annotated with key body joint positions and angles. This annotated dataset serves as the foundation for training and fine-tuning the pose recognition and correction models.

2. Pose Recognition Model:

A deep learning-based pose recognition model is developed using convolutional neural networks (CNNs) or similar architectures. This model processes video input from the user's camera and identifies the current pose within the Surya Namaskar sequence. Transfer learning techniques are employed to enhance accuracy, given the limited availability of labeled yoga-specific data.

3. Pose Correction Algorithm:

An algorithm is designed to assess the user's body alignment against the ideal pose using the recognized joint positions. Deviations from the correct alignment are identified, and personalized corrective feedback is generated. This feedback is presented to the user through the Interface, highlighting specific areas that require adjustment to achieve the correct posture.

4. User Interface Development:

An intuitive mobile or web application is created to provide a seamless interaction between the user and the system. The interface displays real-time video feedback, indicating the user's current pose and overlaying it with the desired pose alignment. Additionally, instructional content, progress tracking features, and motivational elements are integrated to enhance the user experience.

V. CLASSIFICATION

To implement a project on Surya Namaskar pose recognition and correction for smart healthcare, a classification model can be a crucial component. Here's a breakdown of the classification tasks you might need to perform.

1. Pose Recognition:

Classes: Each Surya Namaskar pose can be a separate class.

Data Labeling: Collect a dataset of images or videos with labeled poses corresponding to each stage of Surya Namaskar.

Classification Model: Train a deep learning model for pose recognition. Convolutional Neural Networks (CNNs) or pose estimation models like OpenPose can be considered.

2. Pose Correction:

Classes: Correct and Incorrect poses.

Data Labeling: For a supervised learning approach, you need a dataset of Surya Namaskar poses labeled as correct or incorrect.

Classification Model: Train a model to classify whether a given pose is correct or needs correction. This can be approached as a binary classification problem.

3. User Proficiency Level:

Classes: Beginner, Intermediate, Advanced.

Data Labeling: Collect data with labeled proficiency levels. This could be based on the accuracy of the poses performed.

Classification Model: Train a model to classify the proficiency level of the user based on their performance in Surya Namaskar.

4. Real-time Feedback:

Classes: Positive feedback, Neutral feedback, Negative feedback.

Data Labeling: Label feedback data based on its positivity or negativity.

Classification Model: Train a model to classify the type of feedback to provide to the user based on their pose.

5. Health Impact Assessment:

Classes: Low, Moderate, High impact on health.

Data Labeling: Collect data on the impact of Surya Namaskar on health, considering factors such as heart rate, calorie burn, etc.

Classification Model: Train a model to classify the health impact of a user's Surya Namaskar routine.

6. Biomechanical Analysis:

Classes: Safe, At risk of injury.

Data Labeling: Gather data on biomechanical aspects of poses that could indicate injury risk.

Classification Model: Train a model to classify whether a user's pose is safe or poses a risk of injury.

7. User Engagement:

Classes: Engaged, Distracted, Disinterested.

Data Labeling: Label user engagement based on their interaction with the system during Surya Namaskar.

Classification Model: Train a model to classify the level of user engagement.

8. Overall Performance:

Classes: Poor, Average, Excellent.

Data Labeling: Combine information from various classification tasks to provide an overall performance assessment.

Classification Model: Train a model to classify the overall performance of a user in their Surya Namaskar routine.

VI. CONCLUSION

Surya Namaskar and yoga pose detection have the potential to enhance the practice of yoga by providing valuable feedback, promoting correct alignment, and making yoga more accessible. However, these technologies are not without limitations, including technical challenges, privacy concerns, and cost. When used thoughtfully and in conjunction with traditional yoga practices, pose detection can be a valuable tool for both beginners and experienced practitioners, helping them reap the physical and mental benefits of yoga while reducing the risk of injury. As technology continues to advance, it is likely that pose detection systems will become more accurate and widely accessible, further enriching the yoga experience for individuals and communities alike.

VII. REFERENCES

1. W. Ye, J. Cheng, F. Yang and Y. Xu, "Two-stream convolutional network for improving activity recognition using convolutional long short-term memory networks," *IEEE Access*, vol. 7, pp. 67772-67780, 2019.
2. Carol Mitchell (2003) *Yoga on the ball. inner traditions.* 48
3. S. Deep and X. Zheng, Leveraging CNN and transfer learning for vision-based human activity recognition, *International Telecommunication Networks and Applications Conference (ITNAC)*, 2019.
4. Y. Agrawal, Y. Shah, and A. Sharma, "Implementation of Machine Learning Technique for Identification of Yoga Poses," *IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT)*. Apr. 2020
5. Y. Liu, P. Wang and H. Wang, Target tracking algorithm based on deep learning and multi-video monitoring, *International Conference on Systems and Informatics (ICSAI)*, 2018, pp. 440-444.
6. Newell, Z. *The ancient origins of Surya namaskar sun salutation.*

