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Yoga Pose Detection for Human Rehabilitation Using Deep Leaning

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Abstract: ***Yoga is an ancient science and discipline originated in India 5000 years ago. It is used to bring harmony to both body and mind with the help of asana, meditation and various other breathing techniques It bring peace to the mind. Due to increase of stress in the modern lifestyle, yoga has become popular throughout the world. There are various ways through which one can learn yoga. Yoga can be learnt by attending classes at a yoga centre or through home tutoring. It can also be self-learnt with the help of books and videos. Most people prefer self-learning but it is hard for them to find incorrect parts of their yoga poses by themselves. idea behind this yoga pose detection project using deep learning or neural network learning is that yoga popularity is increasing day by day because of its benefits. Doing yoga helps us physically, mentally as well as spiritually. Because of this many people nowadays are doing it regularly. The main idea of this project is to help the people to recognize which yoga pose they are doing with the help of this detection technique. Yoga which involves 8 rungs and limbs of it, which includes Yama, Niyama, Asana, Pranayama, Dharana, Dhyana and Samadhi. To easily help people understand which pose they are performing via images, video recording by classifying it, we are implementing this project because of this people will incline towards doing more as they will get help to identify which pose they are doing very easily.***

Keywords: Activity recognition, Open Pose, Self Learning, CNN, Deep Learning, media Pipe, Feature Ex- traction, Yoga Pose Detection

I. INTRODUCTION

Human activity recognition is a well-established computer vision problem that has imposed several challenges over the years . 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 biometrics, video-surveillance, human–computer interaction, assisted living, sports arbitration, in-home health monitoring, etc. The health status of an individual can be evaluated and predicted with the help of monitoring and recognizing their activities.Yoga posture recognition is a relatively newer application. [15] Humans are naturally vulnerable to a variety of health issues, with musculoskeletal illnesses being a critical area that needs prompt attention. As a result of accidents or age, a significant number of people experience musculoskeletal diseases every year. Yoga can help you achieve greater physical health. [14] [10] The most common approach to real- time pose detection is to use convolutional neural networks (CNNs) to extract features from the input images, followed by a linear regression step to identify the corresponding poses. [1]]However, this approach has several limitations, such as the difficulty of accurately differentiating between poses, and the need to manually label each pose. [6]To address these limitations, we propose a novel method for real-time yoga pose detection using CNNs, OpenPose, and linear regression in Python. Our method combines the benefits of both approaches, allowing us to accurately differentiate between poses, while also reducing the need for manual labeling. We evaluate our method on a dataset of yoga poses, and show that it is able to accurately identify poses in real-time.

II. PROJECT OBJECTIVES

The objectives of a yoga pose detection project typically revolve around leveraging technology to achieve various goals related to yoga practice, fitness, and wellness. Here are some common objectives:

1) *Accuracy in Pose Identification:* Develop deep learning models that accurately detect and classify various yoga poses in real-time or from images/videos, ensuring precision in recognizing different postures.
2) *Real-time Feedback and Guidance:* Create systems that provide immediate feedback to practitioners, offering guidance on posture, alignment, and adjustments during yoga practice sessions.
3) *Customization and Personalization:* Tailor recommendations and adjustments based on individual practitioners' abilities, body types, and skill levels, providing personalized guidance to enhance their yoga practice.

4) *Improving Accessibility:* Make yoga more accessible to individuals of diverse abilities, ensuring that the technology supports different body types, ages, and levels of experience in practicing yoga.
5) *Preventing Injuries:* Identify incorrect or potentially harmful postures, thus helping practitioners avoid injuries that might result from improper alignment or technique during yoga practice.
6) *Long-term Progress Tracking:* Enable users to track their progress over time, analyzing improvements in their practice and providing insights for continuous development.
7) *Integration with Wearable Tech:* Integrate pose detection capabilities with wearable devices or smart yoga mats to offer real-time feedback during practice sessions, making it more convenient for practitioners
8) *Support for Yoga Instructors:* Provide tools that aid yoga instructors in analyz- ing their students' poses and performance, allowing for more effective guidance and individualized instruction.
9) *Validation against Traditional Practices:* Ensure that the technology aligns with traditional teachings and practices of yoga, collaborating with experts to vali- date the accuracy and relevance of detected poses.
10) *Research and Analysis:* Collect data through pose detection to contribute to research in movement analysis, biomechanics, and the therapeutic benefits of different yoga poses. These objectives collectively aim to harness the capabilities of deep learning to enhance the quality, safety, accessibility, and personalization of yoga practice, fostering a more beneficial and informed experience for practitioners at all levels.

III. LITERATURE REVIEW

This list is not exhaustive but represents a selection of key sources that informed our understanding of the topic.

1) In their paper "Adversarial PoseNet: [4] A Structure-aware Convolutional Network for Human Pose Estimation", implemented a joint occlusion method for a humanb body, which overlapped frequently and led to incorrect pose predictions when used for human pose estimation in monocular images. These conditions may result in pose predictions that are biologically improbable. Human vision, on the other hand, may anticipate postures by taking advantage of the geometric limitations of joint interconnectivity
2) In their paper on simple and lightweight human pose estimation, [5] demonstrated using benchmark datasets that the majority of existing methods often aim for higher scores by utilizing complicated architecture or computationally expensive models, while neglecting the deployment costs in actual use. They examine the issue of straightforward and lightweight human posture estimation in this study.
3) In their paper on continuous trade-off optimization between fast and accurate deep face detectors, [3] demonstrated that DNNs, i.e., deep neural networks, are more effective at detecting faces than shallow or hand-crafted models, but their intricate designs have more computational overheads and slower inference rates. They re- searched five simple methods in this context to find the best balance between speed and accuracy in face recognition
4) In their paper "Yoga Pose Classification Using Deep Learning", [16]proposed a per- sistent issue in machine vision that has presented numerous difficulties in the past. Many industries, including surveillance cameras, forensics, assisted living, at-home monitoring systems, etc., can benefit from human activity analysis. People typi- cally enjoy exercising at home these days because of our fast-paced lives, but many also experience the need for an instructor to assess their workout form and guide them
5) In their paper "Human Pose Estimation with Iterative Error Feedback" presented a deep neural network (ConvNets), [12] a type of deep hierarchical extractor, offer- ing outstanding performance on a range of classifications using only feed-forward neural processing. Al though feed-forward architectures are capable of learning detailed descriptions of the input feature space, they do not explicitly describe interconnections in the output spaces, which are highly structured for tasks such as segmenting objects or estimating the pose of an articulated human. Here, they offer a framework that incorporates top-down feedback and broadens the expressive potential of hierarchical feature extractors to include both input and output regions.
6) In their paper "Yoga Asana Identification: A Deep Learning approach", [11]describe how yoga is a beneficial exercise that has its roots in India, can revitalize physical, mental, and spiritual wellbeing, and is applicable across all social domains. However, it is currently difficult to apply artificial intelligence and machine learning approaches to transdisciplinary domains such as yoga. Their work used deep-learning methods, such as CNN and transfer learning, to create a system that can identify a yoga position from an image or frame of a video.

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7) Used an approach for grading yoga poses presented using computerized visuals representing contrastive skeleton features. [2] In order to assign a grade, the primary goal of the yoga pose classification was to evaluate the inputted yoga posture and match it with a reference pose. The research proposed a contrastive skeleton feature representation-based framework for analyzing yoga poses. In order to compare identical encoded pose features, the proposed method first identified skeleton key points of the human body using yoga position images, which act as an input, and their coordinates are encoded into a pose feature, which is used for training along with sample contrastive triplets.

IV. METHODOLOGY

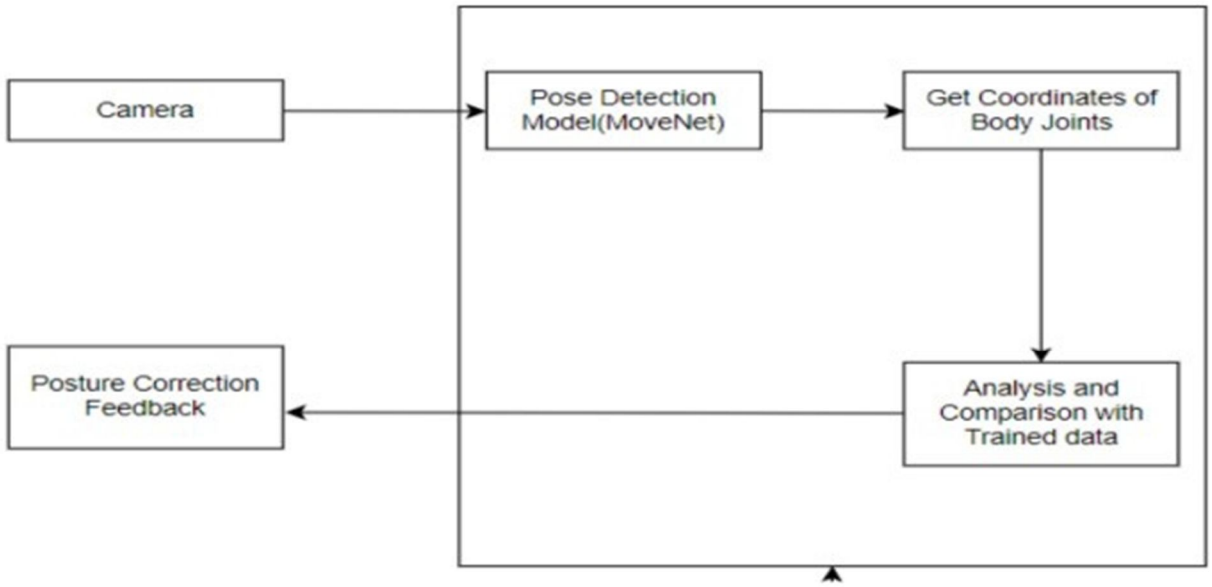

Fig..1. Block Diagram

The organization of the project is as follows:
Estimate the human posture in 2-d images by means of OpenCV [13] and MediaPipe. The System architecture consists of 5 stages: Executing entered commands(By Jupyter Notebook), Making the optic devices accessible, Grabbing the input from that webcam, and analysis of posture to get exact pinpoints to correlate with the already existing data sets.
After this, the live video images are converted into image frames [8]. Then the data set will compare to inbuilt poses. However, the results will get displayed in percentage. The difference will be compared for computing accuracy in a specific exercise. The algorithm used for the analysis and result calculation is done in the neural network functions and methods for each pixel [9]. A win discovery model for operating on the entire images, which returns hand- oriented box bondings. The hand corner model works mainly on the win sensor's cropped images portion, which gives the 3d high dedication coordinates [13]. Mediapipe gives 3D milestones from just a single frame. OpenCV consists of a comprehensive set of classics as well as state-of-the-art computer vision and ma- chine literacy algos. [7] .These algorithms can be used to describe the wrong body posture, identify body bendings, and classify mortals in live video. It sews the high-resolution images of the entire scene, finding similar images from previously entered in the existing database. Making detection from feeds like hand and body position.The system uses the CV3 to get the device optic media access and the mediapipe for sketching the pinpoints on the body, hand, and legs. Apply the styling notations like thickness, circle radius, and color. After successfully recognizing all body posture poses, we will destroy the camera window of the device by command cv2.destroyAllWindows(). These algorithms can be used to describe the wrong body posture, identify body bendings, and classify mortals in live video. It sews the high-resolution images of the entire scene, finding similar images from previously entered in the existing database. Making detection from feeds like hand and body position.

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V. CONCLUSION

In this paper, we have studied how AI-based Smart systems work. We also learned about many exciting fields, like psychology and its direct relation to daily physical exercises. The model will work on suggesting a better way of exercise, and proper posture avoids harm to the body. The use of python libraries like OpenCV, Tensorflow, MAtplotlib, CNN, OpenPose and Mediapipe. We also come to the outcome of many people wanting a personal trainer who cannot afford it due to the high fees, so this will be a revolutionary system in the healthcare field In the future, the system can be further developed to include additional postures and features to improve accuracy and provide more comprehensive feedback.

VI. FUTURE WORK

Absolutely! Here's a simplified look at where yoga pose detection using deep learning could head next:

1) *Getting More Precise:* Making the technology better at understanding small details in yoga poses, like how your hands and fingers are positioned or even subtle shifts in your body
2) *Seeing the Whole Picture:* Figuring out how yoga poses move and change over time, not just in a single moment. This means recognizing when you're moving from one pose to another smoothly
3) *Seeing in 3D:* Making the tech able to understand the space around you, so it knows not just where your body is but how far away different parts are from each other.
4) *Learning from Different Info:* Combining different kinds of information, like videos, sensors that measure depth, or even things like your breathing or heart rate, to understand yoga poses better.
5) *Fitting Different Bodies:* Making sure the technology works well for all kinds of bodies, no matter the size, shape, or abilities of the person doing yoga.
6) *Personalized Help:* Creating tech that learns from how you do yoga and gives you advice or feedback that's just right for you, like a personalized yoga coach.
7) *Working Faster and Anywhere:* Making the tech faster and able to work on small devices so you can get instant feedback during yoga practice, without needing lots of internet or big computers.
8) *Thinking about Privacy:* Making sure the technology respects your privacy and keeps your information safe while still helping you with your yoga.
9) *Learning from Yoga Experts:* Having experts in yoga help make sure the technol- ogy matches what's taught in real yoga practice and supports the whole experience.

These improvements could make the technology better at recognizing yoga poses accurately and giving you helpful advice to improve your practice, all while keeping your privacy in mind!

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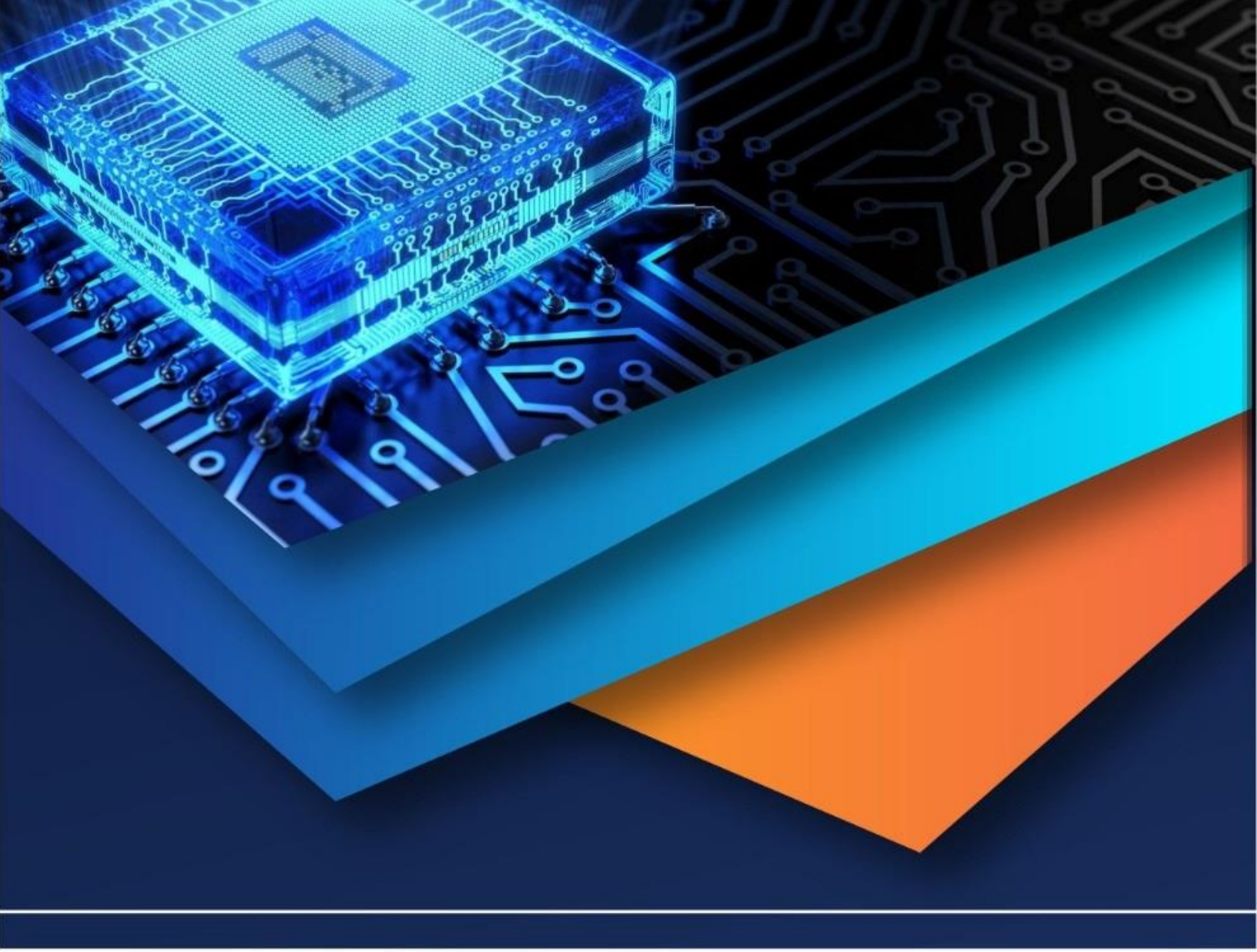

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