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REAL-TIME YOGA-ASANAS TUTORING ANDGYM TRACKER

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***Abstract*—**The advantages of yoga asanas and exercise for physical and mental health are available to people of all ages. To prevent any damage to the bones, muscles, and ligaments, yoga and other gym exercises, postures must be executed correctly, especially when done without an instructor. So, even without a human instructor, the use of artificial intelligence and machine learning combined with picture processing will aid to provide feedback to the performance. With the help of Tensorflow, MoveNet and MediaPipe, this study provides a technique forreal-time posture estimation that identifies pose issues and lets users fix them.

***Index Terms*—**Artificial Intelligence, Machine Learning, CNN, Tensorflow, MediaPipe,MoveNet,yoga,gym.

I. INTRODUCTION

Yoga is a practice that helps to balance the body and mind. It originates from India and has been around for a long time. People who practice yoga frequently feel better physically and psychologically. It's similar to working out both your body and your mind simultaneously.When practicing yoga, it iscritical to execute the positions correctly. This can be difficult,especially if you don't have a teacher to guide you. This is where technology comes in. There are apps and systems that use artificial intelligence (AI) to help you practice yoga more effectively. They can watch you perform the poses and offer advice on how to improve.

There are also specialized programs for tracking your gym workouts. They can tell you how many exercises you've done and whether you're performing them correctly. People find it difficult to keep track of everything on their own, so this is beneficial. These systems employ a technique known as machine learning, which is analogous to teaching a computer to learn from its surroundings. Deep learning is a specific sort of machine learning. It functions similarly to the computer's brain.

Deep learning helps computers understand things better,such as when you perform yoga positions. It can figure out what you're doing wrong and offer suggestions on how to solve it. It supports real-time body tracking. This means that a computer can monitor your movements and notify you if you're doing something incorrectly. For example, if you're performing yoga and your posture isn't quite right, the computer may tell you how to correct it. This is quite beneficialsince it helps you prevent getting wounded.

Today, you don't even need to go to the gym to get a solid workout. There are applications and programs available to help you work-out at home. They use technology such as TensorFlow and MoveNet to monitor your exercise perfor-mance and provide feedback. Pose estimation is a fancy term for the computer's ability to see your body and tell you if you're performing the exercises correctly.Going to the gym orhiring a personal trainer might be pricey. It can sometimes be difficult to make the time to go. That is why it is so convenientto have these AI trainers available for free at home.

We can assist you through workouts and ensure you're doing everything correctly. While exercising, you should pay close attention to your body. If you don't do the exercises correctly, you can get harmed. That's where AI trainers can help. They can monitor you and provide you advice to ensure you're doing things safely. Technology like AI and machine learning is making it easier for people to exercise and do yoga. These tools can watch you, give you feedback, and make sure you're staying safe. With AI trainers, you can get a great workout without even leaving your home.

II. Literature Review

In a series of groundbreaking studies contributing to the field of real-time yoga pose recognition, various methodolo- gies and technologies have been employed, each presenting unique features and accomplishments. [1] One such study,titled "Real-time Yoga recognition using deep learning," was presented at Springer in December 2019 by Santosh Kumar Yadav, Amitojdeep Singh, Abhishek Gupta, and Jagdish Lal Raheja. The authors employed a high-definition Logitech we- bcam to collect a comprehensive dataset from 15 individuals. Utilising OpenPose for key-points detection, their proposed model integrated LSTM for pattern memorization and a time-distributed CNN layer for identifying patterns, achieving an outstanding real-time accuracy of 98.92 percent for a group of 12 users.

[2] Another noteworthy contribution is the study titled "Implementation of Machine Learning Technique for Identification of Yoga Poses" by Yash Agrawal, Yash Shah, and Abhishek Sharma, presented at an IEEE conference in April 2020. This research incorporated six machine learning classification models and successfully identified yoga poses with an accuracy of 94.28 percent. The TF pose estimation method provided joint angles for model training, which was conducted on Google Colab and an Ubuntu 18.04.4 LTS terminal. Future plans include expanding the YOGI dataset with new yoga positions and implementing deep learning modules to enhance overall system performance.

[3] In a different approach, the study "Yoga Posture Recognition By Detecting Human Joint Points In Real Time Using Microsoft Kinect," presented at an IEEE conference in December 2017 by Muhammad Usama Islam, Hasan Mahmud, Faisal Bin Ashraf, Iqbal Hossain, and Md. Kamrul Hasan, proposed a system leveraging Microsoft Kinect to recognize three major yoga poses by detecting human joint points. With an impressive accuracy of nearly 97 percent, the system holds promise for extending its capabilities to recognize additional yoga poses based on reference models.

[4] Faisal Bin Ashraf, Muhammad Usama Islam, Md Rayhan Kabir, and Jasmin Uddin presented the study "YoNet: A Neural Network for Yoga Pose Classification" at Springer in February 2023. This research introduced the YoNet deep learning model for classifying five distinct yoga poses, showcasing its performance against established image classification models (ResNet, InceptionNet, InceptionResNet, Xception). The experimental results demonstrated a notable accuracy of 94.91 percent with 95.61 percent precision.

[5] Lastly, the study "Personalizing Human Video Pose Estimation" by James Charles, Tomas Pfister, Derek Magee, David Hogg, and Andrew Zisserman, presented at an IEEE conference, proposed a technique for personalised video pose estimation. The study showcased that personalised video posture estimation outperformed non-personalized or "generic" pose estimators. Moreover, the method's adaptability was demonstrated in handling multi-person scenarios and occlusion challenges, provided a suitable ConvNet model was employed.

III. METHODOLOGY

A. Yoga and Asanas Tutoring

- Pose Data Collection: Real-time data from web cameras or recorded videos is gathered for analysis. These videos are segmented into individual frames, which serve asthe primary data for training the model. Each extracted image from these frames forms the dataset on whichthe model is trained, enabling it to learn patterns and features essential for its intended tasks, such as object recognition or activity detection. This process facilitates the development of robust and accurate models capableof processing visual information effectively.

- Data Pre-processing: Data pre-processing plays a crucial role, as the collected data comes from diverse sources with varying formats such as JPG, PNG, GIF, and BMP. The images retrieved from search engines undergomanual data cleaning to eliminate noise and ensure the dataset's quality. This step is essential for standardizing the format and quality of images before proceeding with further analysis or training, ensuring consistency and reliability in the dataset for the subsequent stages of the project.

- Pose Identification: Tensorflow's MoveNet model plays a crucial role in identifying poses by measuring keypoints and providing confidence scores for each keypoint. The output of MoveNet comprises heatmaps and offset vectors, which are subsequently inputted into a Convolutional Neural Network (CNN) classifier model. This integration enables the CNN to effectively classify and interpret the detected poses with high accuracy, leveraging the detailed information provided by MoveNet's output.

- Pose Classification and Accuracy Estimation: The CNN classifier is utilized to recognize and classify poses, providing feedback on the accuracy of each pose detected. Additionally, a time counter records the duration of each pose performed, triggering a sound notification upon completion of the designated duration and signaling a green indicator for correctly executed poses. This integrated system offers real-time feedback on pose accuracy and duration, enhancing the user's performance and engagement in the pose training process.

Algorithm Used: The Convolutional Neural Network (CNN) has emerged as a prominent technique for general image classification tasks, offering superior performance compared to traditional methods. Recent advancements in deep learning, particularly within CNNs, have significantly bolstered the accuracy of image detection and recognition. By leveraging convolutional and sub-sampling layers, CNNs effectively extract high-level features from input images, enhancing their ability to discern complex patterns. Moreover, CNNs demonstrate robustness against minor rotations and shifts, further solidifying their utility in various image processing applications.

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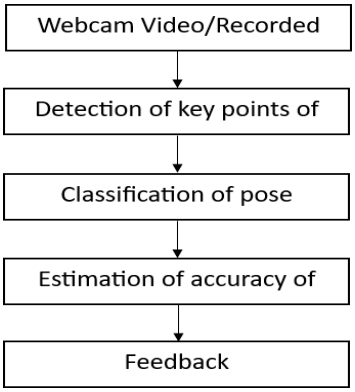

Fig. 1. Framework of Yoga Pose detection

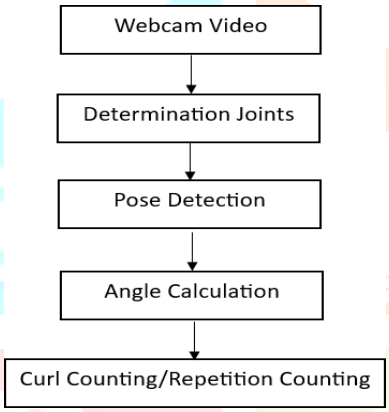

Fig. 2. Framework of Gym Tracker

B. Gym Tracker

- Pose Real-time Repetition Tracking and Joint Positioning: In this phase of the project, real-time tracking of specific exercise repetitions performed by the user is undertaken. This involves the precise positioning of human jointsto create a skeletal representation within images or videos. These joints, including critical points such as wrists, elbows, knees, and ankles, are identified within the image to establish the body's posture. Through advanced algorithms like MediaPipe, these recognizedbody parts are mapped with confidence values indicating the certainty of the human body's presence in the image. Once the structure is mapped, the angles formed by the shoulder, elbow, and wrist joints are calculated, providing essential data for accurately counting exercise repetitions. This comprehensive approach facilitates efficient monitoring and assessment of user performance during workout sessions, enhancing the effectiveness of fitness tracking systems.

- Angle Calculation for Repetition Counting: Once the positions of key joints like the shoulder, elbow, and wrist are established, the angles between them are computed. These angles serve as crucial metrics for understanding the user's movement patterns during exercise. By ana- lyzing these angles over time, the system can accurately track repetitions, helping users maintain proper form and achieve their fitness goals effectively.

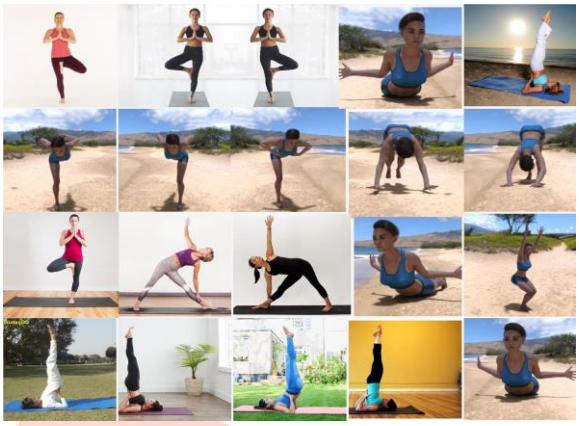

Fig. 3. Dataset collected

Figure 3 depicts the image dataset with 7 classes. Each class contains 700 images. These images are used for yoga pose classification training and testing.An image from each class is chosen randomly.

IV. RESULT AND ANALYSIS

In our study, we developed a Yoga and Asanas tutoring and gym tracking system leveraging Convolutional Neural Networks (CNNs) for yoga pose classification and tracking. Our system achieved a remarkable accuracy of 99 % for classification of yoga poses using CNN and models such as MoveNet, TensorFlow. Gym tracking has a limitation of not covering all exercises. The use of CNN facilitated robust and precise detection, while long short-term memory (LSTM) integration ensured accurate pattern recognition over sequential frames, enhancing system reliability, especially during asana formation and release.

Previous studies have contributed to the field of real-time yoga pose recognition using various methodologies and technologies. The authors of "Real-time Yoga recognition using deep learning" employed a high-definition Logitech webcam to collect a comprehensive dataset from 15 individuals makingthe data collection difficult and time consuming. Our system uses the data publicly available for training and testing thedata by storing the keypoints value of the in a csv file thatfalls under the desired threshold. The authors of "YoNet: A Neural Network for Yoga Pose Classification" , introduced a

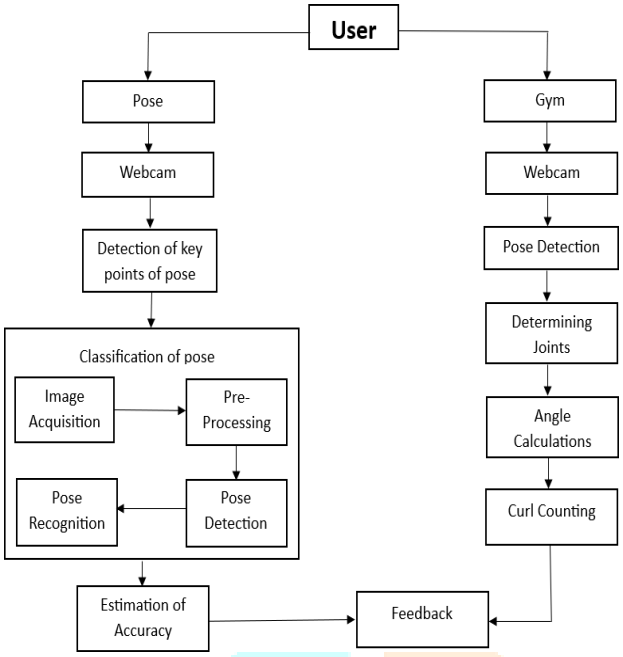

Fig. 4. Proposed System Architecture of Yoga Pose Detection and Gym Tracker

specialized neural network for classifying five specific yoga poses, showcasing its performance against established image classification models such as ResNet, InceptionNet, Inception-ResNet, and Xception with a notable accuracy of 94.91 % and precision of 95.61 %. In contrast, our current system utilizes a CNN-LSTM architecture to recognize seven different yoga poses with accuracy of 99 %, indicating an expansion in pose coverage and potentially enhanced versatility in real-world yoga practice scenarios.

Overall, our system represents a significant advancement in real-time yoga pose detection and gym tracking, with high accuracy and robustness. By integrating techniques and leveraging deep learning frameworks, we contribute to the ongoing efforts to develop intelligent systems for fitness tracking and pose recognition. However, future work mayfocus on expanding the gym tracking capabilities to cover a broader range of exercises and further enhancing the system's adaptability and personalized tracking features, in line with the evolving landscape of fitness technology.

V. Conclusion and Future Scope

Real-time body tracking technology represents a significant advancement, empowering users to gain valuable insights into their movements during exercise. By leveraging this technology, users can identify and correct or incorrect postures during yoga and gym sessions, thereby optimizing their performance and minimizing the risk of injury. This capability fosters a deeper understanding of movement patterns, enabling users to refine their techniques and achieve their fitness goals more effectively.

The software's future evolution promises a comprehensive fitness platform with integrated features like nutrition charts, food suggestions, and calorie estimation, all accessible from a single location. This consolidation aims to streamline users access to vital fitness information, enhancing their ability to make informed choices about their health and well-being.

A standout addition will be the introduction of a nutrition chatbot, offering personalized recommendations tailored to individual dietary preferences and requirements. This feature aims to provide users with practical guidance on making healthier food choices, further augmenting their fitness journey.

In a concerted effort to promote inclusivity, the software will undergo enhancements to support additional languages such as Hindi, Marathi, and other regional tongues. By breaking down language barriers, the software ensures that a wider audience can benefit from its features, regardless of linguistic background. Furthermore, plans to transition the software into a standalone application underscore a commitment to enhancing accessibility across various devices, facilitating seamless usage for users worldwide.

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