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ijirset@gmail.com

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Yoga Pose Detection and Feedback Generation Using Machine Learning

R.Ramesh¹, E.Jaya Lakshmi², G.Krithika³, G.Lakshmi Sai⁴, G.Maheswari⁵, B.Amrutha⁶

Professor, Department of CSE, KKR &KSR Institute of Technology and Sciences, A.P, India¹

B.Tech Student, Department of CSE, KKR &KSR Institute of Technology and Sciences, A.P, India²

B.Tech Student, Department of CSE, KKR & KSR Institute of Technology and Sciences, A.P, India³

B.Tech Student, Department of CSE, KKR &KSR Institute of Technology and Sciences, A.P, India⁴

B.Tech Student, Department of CSE, KKR & KSR Institute of Technology and Sciences, A.P, India⁵

B.Tech Student, Department of CSE, KKR &KSR Institute of Technology and Sciences, A.P, India⁶

ABSTRACT:The project aims at designing a system that can detect a yoga performer's pose in real time and predict whether he/she is doing it correctly or not. We plan on accurately predicting five popular yoga poses namely, downward dog, plank pose, tree pose, goddess pose and warrior-2 pose. This would involve training a ML model to complete the required task. OpenCV would be used for handling the images and pose detection will be performed using MediaPipe. A web application will be developed providing the user a platform to easily perform his task with ease. We present a actual-time on-device hand monitoring pipeline that predicts hand skeleton from unmarred RGB digital camera for AR/VR applications. The pipeline consists of two models: 1) a palm detector, 2) a hand landmark version. It's carried out via MediaPipe, a framework for building pass-platform ML solutions. The proposed model and pipeline structure demonstrates actual-time inference speed on mobile GPUs and excessive prediction great.

KEYWORDS: Yoga, pose, detection, machine learning, prediction.

I. INTRODUCTION

Yoga is a spiritual science which involves physical, mental and spiritual practices aimed at stilling the mind. It has renowned health benefits and is known to improve one's approach towards life. But in order to reap maximum benefits, one needs to ensure that it is done properly. Computer vision techniques exhibit promising solutions for human pose estimation. We aim at implementing concepts of computer vision to train a machine learning model that can be used to predict yoga pose in real time. Several methods are used to for pose estimation. Some such methods are DeepPose, OpenPose, PoseNet etc. We plan on using MediaPipe, a cross-platform, customizable ML solutions for live and streaming media, to achieve our aim. This study proposes an interactive system capable of recognizing 6 poses for learning Yoga that can tune up to six human beings at the equal time.

It is also incorporated with command voices to visualise the instructions and images approximately the poses to be overall performance for the consumer. In order to get a robust database for popularity, the system used Ad boost set of rules although the software development kit mainly for Kinect. All facts changed into educated with the aid of a professional yoga teacher and very last database showed above 94.78% as maximum price for poses analysed in terms of accuracy. Integrating pc vision techniques, the proposed system analyses the practitioner's posture from both the front and aspect perspectives with the aid of extracting the frame contour, skeleton, dominant axes, and characteristic points. Then, based totally at the domain expertise of yoga education, visualized instructions for posture rectification are supplied so that the practitioner can without difficulty apprehend a way to modify his/her posture. Experiments on twelve yoga poses completed via unique practitioners validate the feasibility of the proposed machine in yoga training.

II. LITERATURE REVIEW

[1] The pose system from the previous phase has the advantage that the joint estimation is based totally on the whole photograph and as a consequence is based on context. However, because of its constant enter length of 220×220 , the network has limited capacity to study element – it learns filters taking pictures pose properties at coarse scale. These are essential to estimate tough pose however insufficient to usually precisely localize the body joints. [2] Self-education is essential in sports activities workout. However, without the coaching of a coach, a practitioner may



additionally development to a restrained extent. Improper postures may even motive severe damage to muscle mass and ligaments of the frame. Hence, the development of laptop-assisted self-schooling structures for sports exercising is a currently emerging research topic. In this paper, we endorse a yoga self-schooling machine, which goals at teaching the practitioner to perform yoga poses efficiently, assisting in rectifying terrible postures, and stopping injury.

[3] We present a technique to correctly locate the 2D pose of a couple of people in an image. The method uses a nonparametric illustration, which we seek advice from as Part Affinity Fields (PAFs), to discover ways to partner frame parts with individuals inside the image. [4] The architecture encodes international context, allowing a grasping backside-up parsing step that continues excessive accuracy whilst accomplishing real-time performance, irrespective of the range of people within the photograph. The architecture is designed to together analyse element places and their affiliation through branches of the identical sequential prediction manner. Our approach located first within the inaugural COCO 2016 key points task, and notably exceeds the preceding today's result at the MPII Multi-Person benchmark, each in performance and efficiency.[5] In day by day lifestyles, Yoga has become a famous area around the arena that keeps human beings in correct physical and mental fitness. As well, gesture reputation is a discipline of investigation that takes terrific significance for the self-training of diverse sports activities the use of acquisition strategies including Kinect device.

[6] Over the closing two a long time, deep gaining knowledge of has transformed the sphere of computer vision. Deep convolutional networks had been efficaciously carried out to examine special imaginative and prescient obligations consisting of photo class, photo segmentation, item detection and many extra. By shifting the information found out through deep models on huge typical datasets, researchers had been in addition able to create first-class-tuned fashions for other more particular tasks. Recently this concept turned into carried out for regressing absolutely the digicam pose from an RGB photo. Although the resulting accuracy became sub-optimal, in comparison to conventional function-based solutions, these attempts led to a surge of mastering-based totally pose estimation methods. Here, we overview deep learning methods for digital camera pose estimation. We describe key methods inside the subject and identify tendencies aiming at enhancing the authentic deep pose regression solution. We similarly offer an intensive move-comparison of current studying-primarily based pose estimators, collectively with sensible notes on their execution for reproducibility purposes. Finally, we talk emerging solutions and capacity future research guidelines.

III. EXISTING SYSTEM

In current years, there are associated works on yoga pose detection and category. Key point detection techniques used are OpenPose, PoseNet, and PifPaf. To detect human pose, many factors could be considered consisting of environment, human interactions, and versions in apparel. Limitations inside the above works are that features (key points) aren't scaled and are unable to find a sample for human poses of different distances from the camera. Previous techniques that used joint angles as functions are rotational invariant (even if joints are turned around, the angles among them are not modified). We suggest a method for human pose estimation based on Deep Neural Networks (DNNs).

The pose estimation is formulated as a DNN-based totally regression problem toward frame joints. We present a cascade of such DNN regressors which ends up in high precision pose estimates. The approach has the advantage of reasoning approximately pose in a holistic style and has an easy however yet effective method which capitalizes on latest advances in Deep Learning. We gift a detailed empirical analysis with country-of-artwork or higher performance on 4 academic benchmarks of numerous real-global photos. The pose system from the previous phase has the advantage that the joint estimation is based totally on the whole photograph and as a consequence is based on context. However, because of its constant enter length of 220×220 , the network has limited capacity to study element – it learns filters taking pictures pose properties at coarse scale. These are essential to estimate tough pose however insufficient to usually precisely localize the body joints.

Note that we cannot effortlessly increase the input size on the grounds that this could increase the already large wide variety of parameters. In order to acquire better precision, we advise to train a cascade of pose regressors. At the primary degree, the cascade starts off with the aid of estimating an initial pose as mentioned in the previous segment. At next levels, additional DNN regressors are educated to are expecting a displacement of the joint places from previous level to the authentic area. Thus, every subsequent stage may be concept of as a refinement of the presently predicted pose,

IV. PROPOSED SYSTEM

Yoga, if done properly has vast health benefits. But if performed incorrectly it can cause a lot of problems like ankle sprain, stiff neck, muscle pulls, etc. Thus, at least in initial stages yoga must be performed under an experienced

instructor. This might not always be possible, owing to expensive yoga classes and social distancing restrictions being imposed around the world.

This project mainly focuses on pre-processing datasets to extract new features like angles between body parts and how they improve accuracy compared to traditional pose features and by filling missing values. This device makes use of class networks like multi-layer perceptron and hyper parameters tuning to reap proper accuracy.

The proposed approach maintains low computational complexity, can be applied to someone's busy lifestyles for self-yoga mastering, and can stumble on wrong yoga posture to keep away from continual problems.

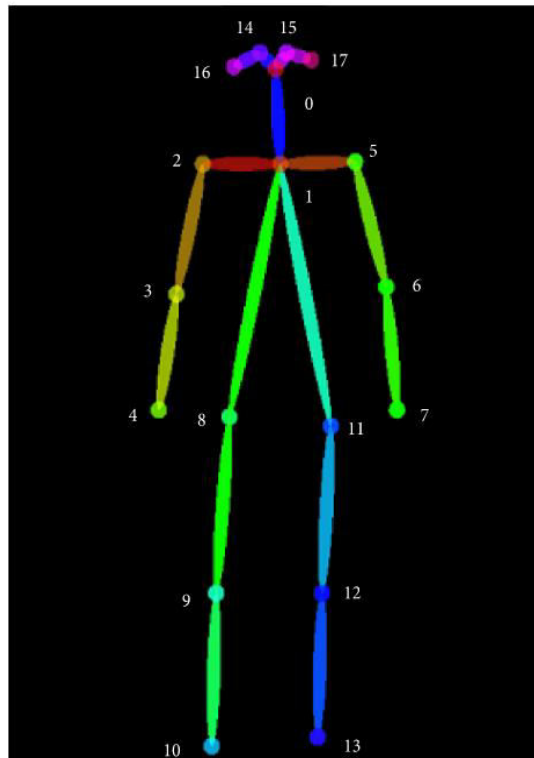


Fig: Extraction of key points from a frame

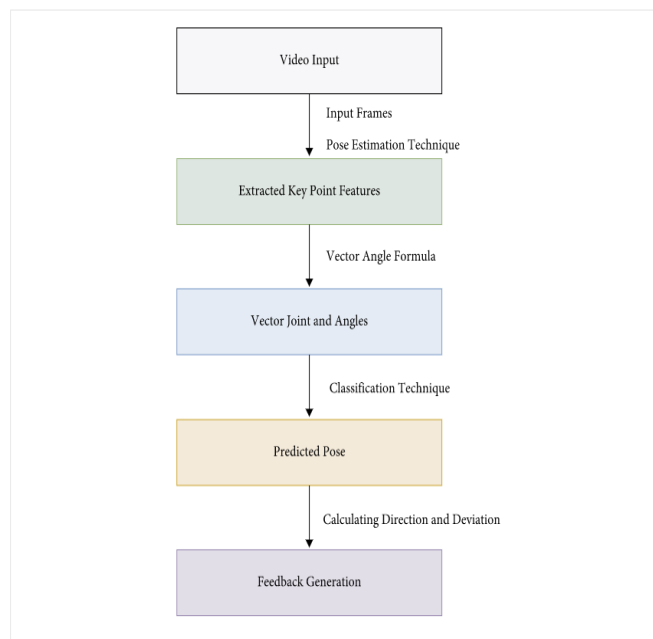


Fig: Flow of Proposed System

V. SYSTEM ARCHITECTURE

Machine learning based yoga pose detection methodology presented is proposed to detect correct yoga poses and provide feedback to improve the yoga posture.

The proposed approach has consists of three main steps:

Feature extraction: videos or images are given as input to the model, and frames are extracted at regular intervals from videos and sent to Keras multiperson pose estimation to extract key points. From these key points, joint vectors are calculated. For all these joints, angles between the x -axis and joints are found, respectively.

Classification: These angles are sent to the classification model to classify the pose among yoga poses. These angles are compared with an array of angles of the classified pose. This array contains average angles of joints from the dataset.

Feedback generation: the differences are calculated, respectively, for every angle, and suggestions are revealed for every angle. Based on the sign of difference, whether to rotate joints in clockwise or anticlockwise direction is given as feedback output.

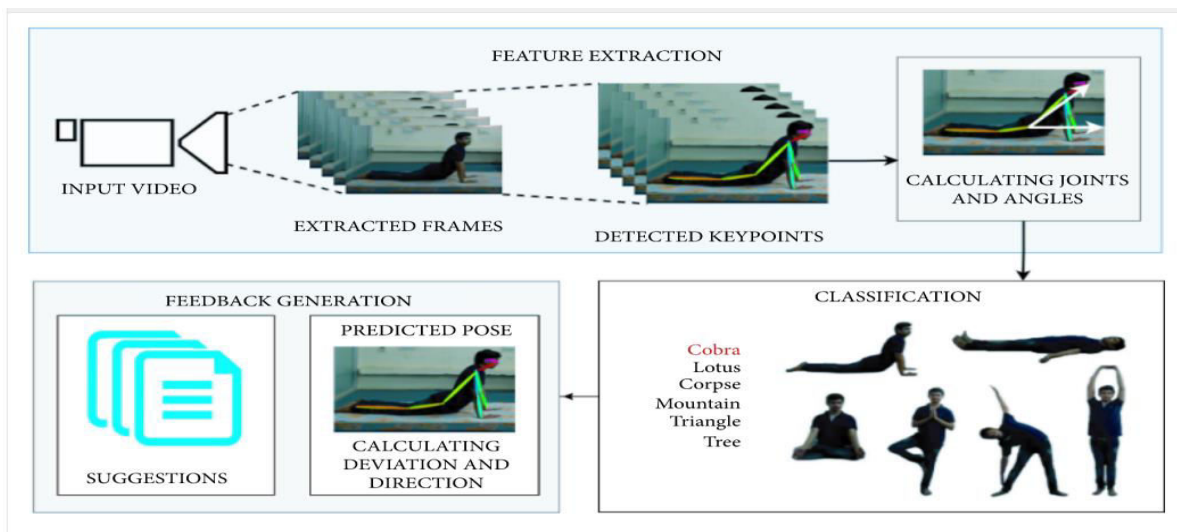


Fig: Propose System Architecture

WORK FLOW:

- Built a dataset with poses using a webscraper.
- Once the dataset was cleaned and processed, we loaded it and converted the images into required format.
- To Train a model to perform yoga pose detection, It includes loading the mediapipe model to obtain landmarks on the images, taking training dataset as input, data preprocessing, dividing the dataset, creating the model using multiple algorithms and testing the model using certain metrics. This is done with the help of sklearn, matplotlib and opencv.
- Now that we've trained the model, we need to use the model to perform predictions.
- This part is done using python, which includes different functions to take image as input via upload or run a live feed using webcam.
- The images are handled using opencv.
- Flask is used to work with the frontend, which is then integrated with HTML pages, styled using CSS and Javascript.
- Different components of functions have different endpoints which render a certain component according to functionality needed.

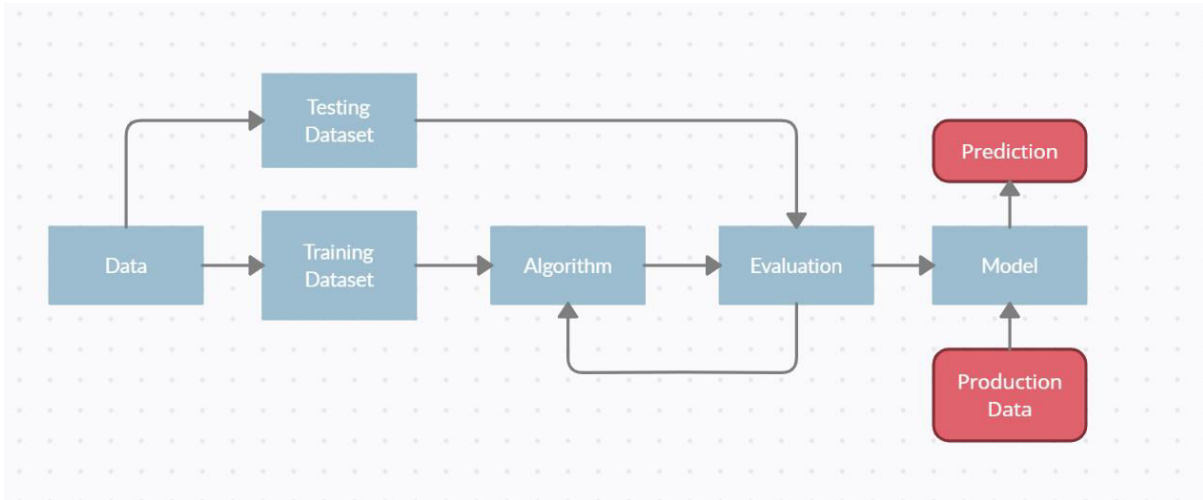


Fig: Flow Diagram of Proposed System

ALGORITHMS:

- **Logistic Regression**, a statistical analysis(also known as logit model) is often used for predictive analytics and modeling and extends to applications in ML.
- **Random Forest Classifier** consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction.
- **Gradient Boosting Classifier** is a special type of Ensemble Learning technique that works by combining several weak learners into a strong learner. This works by each model paying attention to its predecessor's mistakes.
- **KNN Classifier** is a supervised ML algorithm which assumes that similar things exist in close proximity. It considers K Nearest Neighbors (Data points) to predict the class or continuous value for the new Data point.
- **Ridge Classifier**, based on Ridge regression approach, converts the label records into [-1, 1] and solves the trouble with regression approach. The highest price in prediction is popular as target magnificence and for multi magnificence data multi-output regression is carried out.

VI. CONCLUSION

The world has seen a tremendous rise in fitness community over the past decade. People from all walks of life are becoming much more conscious about their general health. Yoga has turned out to be a go-to choice for many but with the digital age looming on us, people find it difficult to properly learn and perform yoga with correct posture. Performing any pose with incorrect body posture cannot only waste ones time & efforts but it can also prove to be quite counterproductive for your body as it increases risk of several muscle injuries. This problem can be avoided by creating a system that intelligently detects your current form and helps in rectifying it, thus ensuring that an individual gets maximum benefits out of their hard work. In our project we use MediaPipe to determine the accuracy of a yoga pose. MediaPipe analysis all available landmarks in human body & their position relative to each other in order to quantify the correctness of body posture. Our work will have a positive impact on all fitnessenthusiasts who will be able to easily judge the accuracy of their favourite Yoga-Pose and live with a healthy and sustainable lifestyle.

VII. FUTURE WORK

With the blazing speed at which computer vision is evolving, new pose estimation techniques and models will soon replace the tried and true methods of today. Using better models and techniques in the future for improvement of the model is something we'd certainly be interested in. Extending our work with a number of other popular yoga poses is also on the cards. Improving the model we develop with new, improved and thorough datasets with a higher usability could also be possible.

Adding a whole new design language to the project by introducing UI elements is also possible. Developing a web application or a native app will also help in the distribution of this idea.



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