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Yoga Pose Detection Using Machine Learning

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ABSTRACT: Yoga is a new way to look at the disciplines of our lives, such as physical, mental, and spiritual practices. Yoga started many years ago. Because of the many benefits of yoga, medical professionals and many celebrities suggest doing yoga for a healthy lifestyle. Taking care of your body, mind, and breath is a simple definition of yoga. However, depending on the COVID-19 situation, everything happening from home in this situation it is important to maintain your health.You need to do exercise daily. To do the exercise properlyan instructor is needed at home that you cannot do in the COVID-19 situation. It is injurious to our health to do yoga poses without an instructor. So here we are going to represent a proposed model for yoga pose detection using a machine-learning algorithm to identify and detect the yoga pose form. Our system works on 8 yoga poses. We have developed a GUI-based desktop application using the Tkinter library. The input is preprocessed in the form of an image, the object is detected, and the core of the human body is identified using the media pipe and OpenCV library. For training and testing data, we use CSV files downloaded from Kaggle. We use logistic regression models for training and testing. The system gets an accuracy score of 100%.

KEYWORDS: Media pipe, OpenCV, Machine Learning, Logistic Regression

I. INTRODUCTION

Human pose recognition is extremely troublesome and difficult task within the discipline of computer vision. It deals with localization of human joints in a picture or video to make a skeletal illustration. To mechanically discover a user's activity in a picture may be a troublesome drawback because it depends on variety of aspects like scale and determination of the image, illumination variation, background muddle, venture variations and interaction of humans with the environment. There are diff rent types of yoga aasan are available world wide.

Each yoga aasan have unique quality that helps body to stay physically and mentally fit. The Yoga is as important as food in human life to live healthy and happy life but to do yoga practice correctly is very important so there is a need of instructor which helps individual's posture evaluation and instruct them. Since not all users have access or resources to an educator, the digital applications which operates using artificial intelligence.In recent years, human pose detection has benefited greatly from machine learning and large gains in performance are achieved. Machine learning approaches give an additional simple approach of mapping the structure rather than having to wear down the dependencies between structures manually.

This project focuses on exploring the various types for yoga pose classification and try to realize insight into the following: what is pose detection? What is Machine learning? However will machine learning be applied to yoga pose detection in real-time? This paper take help of research papers, conference and journal as a reference to build project. The primary section of the project talks concerning the history and importance of yoga. The second section talks concerning cause estimation and explains differing kinds of pose estimation ways thoroughly and goes one level deeper to elucidate descriptive ways – learning primarily based (machine learning) and model.

Totally different pose extraction ways are then mentioned in conjunction with machine learning primarily based models - logistical regression and python library like MediaPipe, OpenCV for pose estimation. We have a tendency to developed interface primarily based desktop application in that—during which—within which user has to register when with success login it opens a brand-new window on which user takes edges of our system there is facilitated button provided for reference purpose by clicking on recognize button it opens camera and determine the yoga posture show the name of yoga pose and probability

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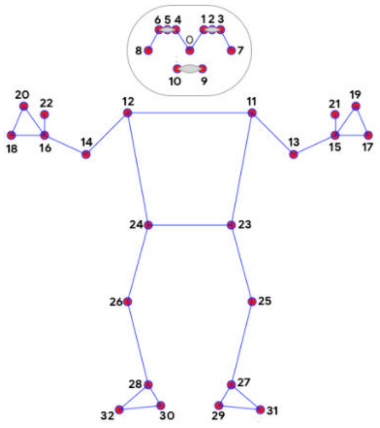
II. RELATED WORK

1.Human Pose Estimation :-

Human posture recognition has created vast advancements within the past years. it's evolved from second to 3D create estimation and from single person to multi-person create estimation. Uses pose estimation to make a machine learning application that helps find shoplifters whereas uses one RGB camera to capture the 3D poses of multiple folks in time period. Human pose estimation algorithms may be wide organized in 2 ways that. Algorithms prototyping estimation of human poses as a geometrical calculation are classified as generative ways where as algorithms modelling human create estimation as a picture process drawback are classified as discriminative methods. in a different way of classifying these algorithms relies on their methodology of operating and therefore the major work behind that approach. Algorithms ranging from a higher-level generalization and moving down are known as top-down ways, whereas algorithms that begin with pixels and move upwards are known as bottom-up ways.

2.Keypoints detection:-

Human pose estimation from video plays an essential role in varied applications like quantifying physical exercises, language recognition, and full-body gesture management. For instance, it will type the premise for yoga, dance, and fitness applications. It also can change the overlay of digital content and data on prime of the physical world in increased reality. hence media pipe is best fit model for video pose estimation. It uses the concept of BlazPose to detect the keypoints which identified using respective joints. For a nonvisible joint, it predicts the coordinates of the joint using the concept of Leonardo's Vitruvian man and hence the midpoint of person's hip, the radius of a circle consisting of human and inclined line angle connecting shoulder and hip's midpoint is predicted.



0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

Fig.1. Pose landmarks on human body with KeyPoint

3. DataCollection :-

We are working on total 8 yoga aasans which are Vajrasan, Shavasaan, Gomukhasan, Bhadraasan, Dhanuraasan,Shrishasan, Sarvangasan and Chakrasan. We are collected total 20,000 images dataset in the form of x,y,z and v coordinates which is stored in CSV file format. To run model on machines requires 8GB RAM or above. Software Requirements are Anaconda navigator which having Spyder and command prompt it supports windows, Linux and Mac-OS operating systems. To give database connection we used DB SQLite server.

4. Pre-processing step :

The data pre-processing method is an important step it helps to remove noisy data and clean data and make path safe for machine learning model. We need to normalize the data first. We used Python Imaging library(PIL) for data pre-processing it provides important features such as extensive file format, efficient internal representation, creating thumbnails, converting image files format, applying filters to images. To install PIL library to our system give command pip install pillow.

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Fig.2 Preprocessing

5. Feature Extraction :

Feature extraction is done using Media pipe and OpenCV libraries need to follow the steps at the time of feature extraction 1.we Collect image samples of the target exercises and run pose prediction on them.2.we need to Convert obtained pose landmarks to a representation suitable for the classifier and form a training set using these we converted key points in vector format.3.Then we performed classification itself.

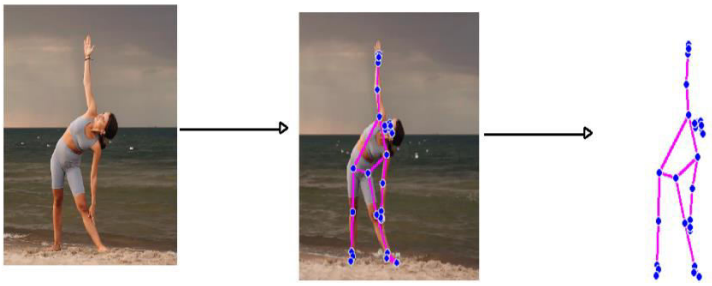

Fig.3feature extraction

III. PROPOSED ALGORITHM

Model : All the x, y and z coordinates of the joint points determines the structure of every single yoga position. We used logistic regression model to classify data and detect the yoga pose.Thex,y and z coordinate are passed to model as X(input variable)i.e feature data and y (output variable) i.e targeted value. We used 70% data for training and 30 % for testing. Our model gives accuracy near 100%.

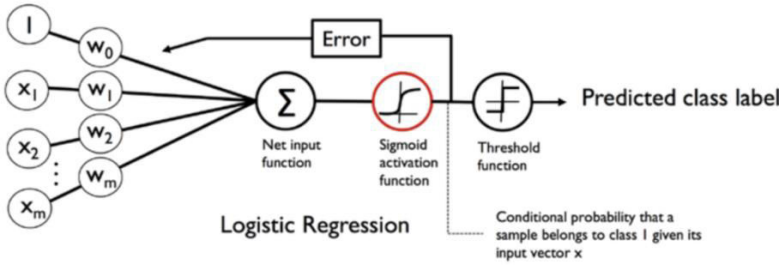

Fig 4. Logistic regression

Logistic Regression can be expressed as :

$\log\left(\frac{p(X)}{1-p(X)}\right) = \beta 0 + \beta 1X$...(1)

Where, the left side of equation is the logit or log-odds function, and

$\left(\frac{p(X)}{1-p(X)}\right)$…(2) is the odds.

The odds detect the ratio of probability of success to probability of failure. Hence linear combination of inputs are mapped to the log(odds). In logistic regression the output being equal to 1.If we take the inverse of above function,

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We get : $p(X) = \frac{e^{\beta 0+\beta 1X}}{1+e^{\beta 0+\beta X}}$ …(3)

This is called as Sigmoid function and it is shown by S-shaped curve. It always provides the value of probability that has range from 0 to 1.

Sigmoid Function :

The reason because sigmoid function is used is that it exist between(0 to 1),which may predict the probability as 0 and 1. In logistic regression ,a linear equation is used to predict a value with independent predictors.The output of algorithm must be a class variable i.e 0 means no, 1 means yes. To bring this output sigmoid function is used.

$Z = \theta 0 + \theta 1x1 + \theta 2x2 + ...$ (4)

$g(x) = \frac{1}{1+e^{-x}}$ (5)

$h = g(z) = \frac{1}{1+e^{-z}}$(6)

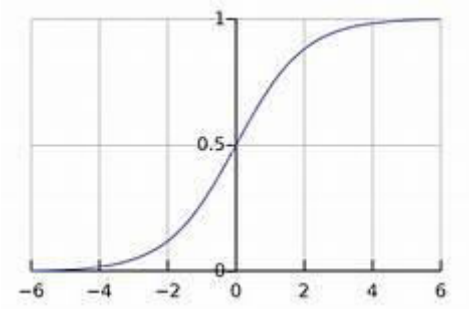

Fig 5. Sigmoid activation function

The linear equation output(z) is given to function g(x) which returns compressed value of h, and the value of h is between the range 0 to 1. The graph makes us visualize that how the sigmoid function compresses the values within the range. 1, but this seldomis the case. as described in the graph ,the sigmoid function becomes asymptote to y=1 for positive values of x and becomes asymptote to y=0 for negative values of x.

IV. SIMULATION RESULTS

Our system successfully detect the yoga pose and make prediction accordingly we worked on total 8 aasans which are Vrikshasan, Bhadrasan, Gomukhasan, Shavasan, Chakrasan, Shrishasan, Sarvangasan and Dhanurasan. Our model gives 99% accuracy so from that we say our system does excellent job. It display the name of aasana and the probability range from 0 and 1. If the probability is 1 or near to 1 then it predicts the right yoga pose. If the probability near to 0 or 0 then the system prediction is false.Which helps user to do yoga aasans correctly. We made a desktop application it is user friendly.To take benefits of our system user needs to successfully register and login. Here are the some snaps of real time yoga pose detection.

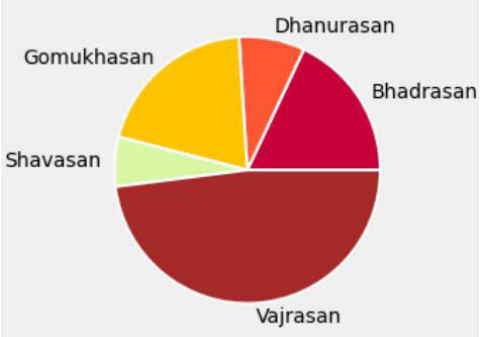

Fig. 6 value count of every target variable

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We test two other models Support vector machine and Naïve bayes algorithm In comparison with logistic regression we get following result which shown in fig.7

Sr.no	Machine Learning Model	Accuracy	Precision	Recall	F-1 Score
1.	Logistic Regression	1.00	1.00	1.00	1.00
2.	Naïve Bayes	0.99	0.99	0.99	0.99
3.	Support Vector Machine	1.00	1.00	1.00	1.00

Fig.7 Analysis using different models

V. Conclusion and Future Work

In this paper, we built the system which helps individual to do yoga correctly by instructing them. Currently we worked on eight yoga poses but in future it works on many yoga poses.based on the requirement. We have detected the yoga poses considering up to 100% accuracy.

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