Pose & Posture Estimation(Yoga Asanas)

PROJECT SYNOPSIS

Machine Intelligence

BACHELOR OF TECHNOLOGY
V Sem A Section CSE

Department of Computer Science & Engineering

SUBMITTED BY

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Abstract and Scope

Image recognition has been one of the most important fields of image processing and computer vision, and yoga pose estimation would be the one encountered many challenges.

Yoga pose estimation is a deep-rooted problem in computer vision that has exposed many challenges in the past. Analyzing human activities is beneficial in many fields like video surveillance, biometrics, assisted living, at-home health monitoring etc.

The problem with yoga however is that, just like any other exercise, it is of utmost importance to practice it correctly as any incorrect posture during a yoga session can be unproductive and possibly detrimental. This leads to the necessity of having an instructor to supervise the session and correct the individual's posture. Since not all users have access or resources to an instructor, an artificial intelligence-based application might be used to identify yoga poses and provide personalized feedback to help individuals improve their form

With our fast-paced lives these days, people usually prefer exercising at home but feel the need of an instructor to evaluate their exercise form. As these resources are not always available, yoga pose recognition can be used to build a self-instruction exercise system that allows people to learn and practice exercises correctly by themselves.

Human activity analysis would be useful in many areas. Especially under the circumstance of the Covid-19 pandemic, human pose recognition would be helpful for people to do some self-instructed yoga and receive real-time feedback for daily simple exercise when staying at home all day long. In this case, our project would focus on the yoga poses, looking at the features of the yoga pose images, pre-processing the images for better training, building various deep learning models for pose classification and comparing results among different models.

This project lays the foundation for building such a system by discussing various machine learning and deep learning approaches to accurately classify yoga poses. The project focuses on building machine learning and deep learning models which can accurately classify the toga pose images.

The objective of this project is to classify the yoga poses with the highest possible accuracy using deep learning techniques like Convolutional Neural Networks.

Keywords – Human pose estimation, yoga, machine learning, deep learning, Convolutional Neural Networks.

Feasibility Study:

Main purpose of yoga pose grading is to assess the input yoga pose and compare it to a standard pose to provide a quantitative evaluation as a grade.

Some Yoga Practitioners do not perform their yoga posture properly which leads to many body problems like pain in the joints, disc-misalignment, shoulder pain.

It is important to perform Yoga exercises, so our project helps identifying if the yoga pose performed is correct.

Users may not have access to an instructor, an artificial intelligence-based application might be used to identify yoga poses and provide personalized feedback to help individuals improve their form

Yoga pose recognition would be helpful for people to do self-instructed yoga and receive real-time feedback for daily simple exercise when staying at home.

Recognition of posture is a challenging task due to the lack availability of dataset and to detect posture on real-time bases.

To overcome this problem a large dataset has been created which contain at least 2500 images of ten different yoga pose.

Deep learning approaches provide a more straightforward way of mapping the structure instead of having to deal with the dependencies between structures manually.

Design Approach/ Methodology/ Planning of work

The following are steps followed during our project:

Step 1. Importing Required Modules and Understanding the dataset

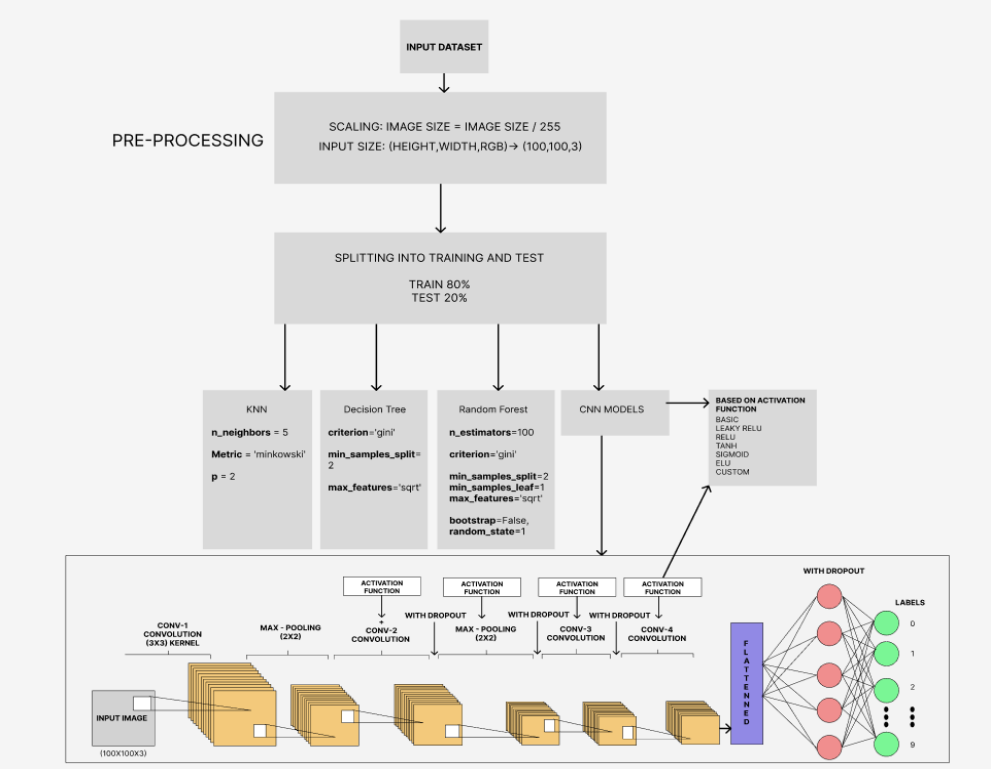
Step 2. Importing the Images from dataset folder

Step 3. Scaling and splitting the data into Train and Validation

Step 4. Building the following Models and performing Hyper Parameter Tuning:

1. Decision Tree Classifier, Random Forest Classifier, KNN.
2. CNN Models:
    - 1 Convolutional Layer
    - 3 Convolutional Layers - LeakyRelu Activation Function
    - 3 Convolutional Layers - Relu Activation Function
    - 3 Convolutional Layers - Tanh Activation Function
    - 3 Convolutional Layers - Sigmoid Activation Function
    - 3 Convolutional Layers - Elu Activation Function
    - 3 Convolutional Layers - Custom Activation Function
    - ReLU + Custom Activation + Tanh
    - ReLU + Tanh + Custom Activation

High level architecture diagram



References

The following the IEEE Papers which we referred and analyzed for our project:

PAPER 1: Computer Vision Towards Data Science

Date: 24 June 2020

Published in: IJCRT

Description: Understood how Deep Learning works for Image feature extraction and classification. Techniques used in Deep Learning are Object Detection, Object Recognition, Object Classification, Object Segmentation. CNN has 3 main layers:
(i) Convolutional layers(ii) Pooling layers(iii) Fully connected layers

PAPER 2: A Study on Various Classifier Techniques Used in Image Processing

Date: 15 May 2020

Published in: 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS)

We understood the comparison of various Image classification algorithms. The classifiers utilized are KNN, SVM, and CNN. The precision accomplished by every classifier is 48.63%, 60.5%, and 96.49% individually. Conclusion: Thus, CNN would be the best choice over other algorithms since it is having a significantly higher accuracy.

PAPER 3: Image Classification using Convolutional Neural Network

Date: 18 February 2022

Published in: 2022 First International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT)

Through this paper, we were able to understand how CNN works to solve image classification problems. Understanding the various steps involved for image classification using CNN, like importing key libraries, reshaping the data, normalising the data, defining the model function, running the model, and understanding the different layers of CNN.

PAPER 4: The Role of Activation Function in CNN

Date: 18 December 2020

Published in: 2020 2nd International Conference on Information Technology and Computer Application (ITCA)

Through this paper, we were able to understand the various activation functions used in CNN. Also, several activation functions commonly used by researchers are compared one by one, and qualitative comparison results are given by combining them with specific neural network models. Understand what the characteristics of an ideal activation function are.

PAPER 5: Comparison of Performance by Activation Functions on Deep Image Prior

Date: 13 February 2019

Published in: 2019 International Conference on Artificial Intelligence in Information and Communication (ICAIIC)

In this paper, they compared the performance of activation functions like the linear unit (ReLU), leaky rectified, linear unit (leaky ReLU), and the randomised leaky rectified linear unit (RReLU). The aim is to observe the effects of differences in the activation functions. Conclusion: The RRelU had the best performance in the denoising and inpainting experiments, but the ReLU performed best in the super-resolution experiment.

PAPER 6: Hyper Parameter Optimization of Convolutional Neural Networks

Date: 21 October 2021

Published in: 2021 International Conference on Advances in Computing and Communications (ICACC)

Understand hyper-parameter tuning for CNN models. Hyper-parameter tuning of the convolutional neural network is performed by using two techniques: grid search and randomised search technique. Comparison between the grid search and the randomised search Hyper-parameter Tuning.

PAPER 7: Implementation of Machine Learning Technique for Identification of Yoga Poses

Date: 12 April 2020

Published in: 2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT)

Understand how image classification can be used for yoga pose classification. Compare the various image classification algorithms like SVM, random forest, logistic regression, KNN, DT, and Naive Bayes for yoga pose classification.
Conclusion: The highest accuracy was obtained by using a Random Forest Classifier.

PAPER 8: Deep Learning Based Yoga Pose Classification

Date: 15 August 2022

Published in: 2022 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COM-IT-CON)

Understand the method for real-time pose estimation that uses the deep neural network model to detect and fix errors in a person's stance. Understand the four layers of CNN and the purpose of each layer. The challenges to be solved in the field of pose classification include providing individual feedback to the user performing the pose.

PAPER 9: INFINITY YOGA TUTOR: YOGA POSTURE DETECTION AND CORRECTION SYSTEM

Date: 04 December 2020

Published in: 2020 5th International Conference on Information Technology Research (ICITR)

Understand how to identify 25 key points in the human body. How to build a pose detection module that consists of a Deep Learning model, Convolutional Neural Networks analyse and predict user pose, or asana, using a sequence of frames. The following steps explain how they work: Key point detection using Open Pose, key point detection using Mask RCNN, Higher Probability prediction, & comparison.