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# Wrong posture detection with OpenCV and Support vector machine

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**Abstract:** Since technological revolution, the health of normal human being has tainted a lot. Over past ten years there is a heavy demise in the health (both physical and mental health) of the people. The life expectancy rate has seen a downfall and has gone below 65 years of age. To sustain this life expectancy rate and to make people aware about their physical fitness, we have tried to design a process with the help of opencv, machine learning and deep learning algorithm to detect wrong postures and subsequently asking the user not to be in that particular position which can harm the body. For the entire process we have used opencv for image and video processing, support vector machine (SVM), recurrent convolutional neural network(R-CNN) (*proposed*) to determine the wrong posture by ensuing training the dataset and testing the unknown input images. We have also provided an analysis for physical health of people of India (region wise) over the past few years.

Keywords: postural deformity, opencv, SVM, deep learning, R-CNN, predictive analysis, time series analysis

## Introduction

In this paper we have tried to focus mainly on the postural deformities that are caused due to improper postures that we inculcate in our everyday life. The overall work flow is designed in such a manner that whenever a person is in state of wrong posture, the developed model will immediately inform the user that he/she is in the wrong postural state and he/she needs to change it, also it will inform what will be its adverse effect on that person. For carrying out the entire process we are taking the help of openCV and masked recurrent convolutional neural network to obtain the maximum classification accuracy. We have also tried to predict the health of a person. We are trying to develop our own real life dataset for all the age groups.

## Various postural deformities

There are various postural deformities that can occur from our day to day movement and postures. Common postural deformities encompasses Spinal curvature (Kyphosis, lordosis, scoliosis), Flat foot Knock knees, Bow legs, Round shoulders [1], smart phone syndrome which is now majorly seen in children in the age group of 6 to 10 years. These common deformities in long run results in major postural deformity and results in ankylo spondylitis, arthritis etc. which leads to the lower life expectancy rate.

## Workflow

The workflow for the overall process is shown in the process flow chart for SVM and R-CNN. These procedure has been kept same for both SVM and masked R-CNN. Starting from preparing the dataset, labeling the features extracted from the images, splitting the dataset into training and testing dataset and evaluating the model on the basis of cost function and gradient decent and attaining the classified wrong posture and predicting the postural deformity out of it.

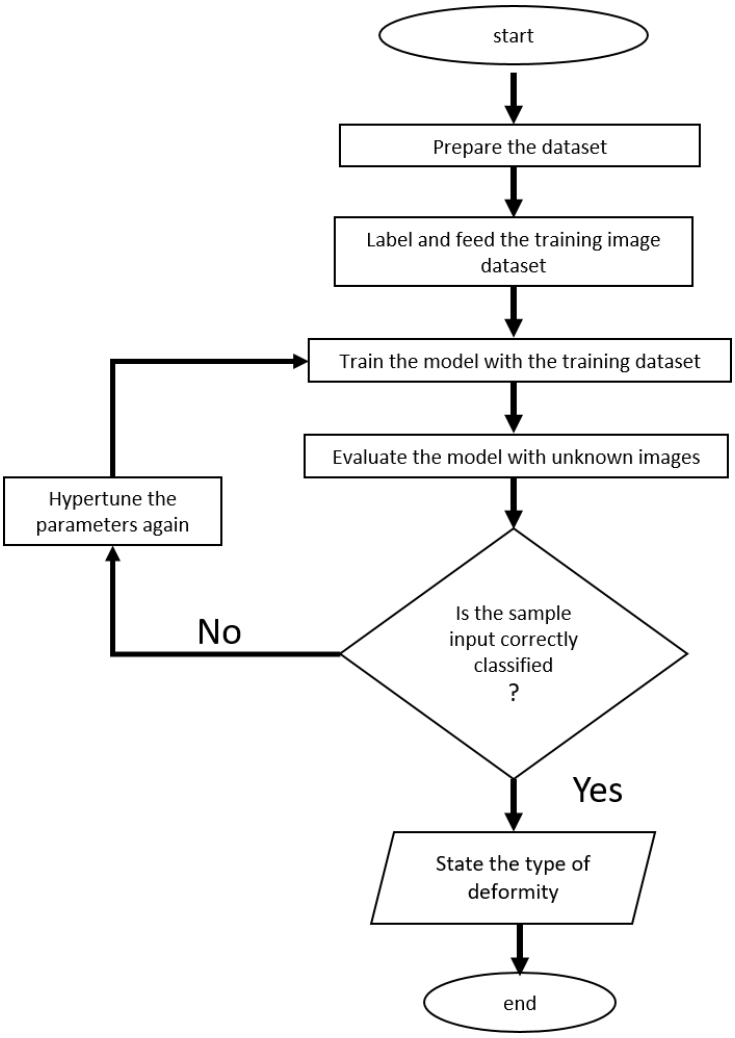


Fig.1. Flowchart for overall process using support vector machine classifier

## Software, modules and models required

We have executed our entire process with the help of python 3.6 programming language (IDLE), opencv2 module, numpy module, pandas, pillow, scikitlearn, matplotlib, Tensorflow, keras. In our early stage we are using haarcascade xml file of opencv to recognize the image and the video. Along with these modules we have used support vector classification of SVM for classification purpose. For deep learning part we are taking help of masked R-CNN since it is best for accomplishing image related data.

## Procedure

We have divided the overall procedure in two segments, first the image or video will be captured through normal camera with minimum specification and with the help of haarcascade upper and lower body xml file of opencv, we will get the 2 region of interest i.e. one for upper body and one for lower body, since we are considering the full body posture. Once we get the image with our requirements we will store it in a file and subsequently we will gather more images with different types of posture for better prediction and learning rate. Once we have the images file, we will be deriving the numerical data out of it for training our model.

Once we are done with the data extraction we will move towards the training of our SVM model with multiclass support vector classification. Before training the model, the dataset is distributed into training set and testing set, for our consideration, we have taken 80 per cent of dataset as training set and rest 20 per cent as testing set. Once done, we evaluate the model depending upon its predicted value by cross validation and gradient decent method.

If we get the predicted value over 0.80, then the corresponding postural deformity information will be provided by a text saying you are in the wrong posture and predicting the conforming deformity.

In the similar manner we will be working with masked R-CNN to train neural network with different weights and activation function. Till now we have proposed to work with reLU and softmax activation function with dense layer having weight of twenty. For gaining high accuracy without much error we will be using feed forward and back propagation method.

## Mathematical formulae

For our image recognition we have used openCV to detect images since it contains 2 frames in a single window we have to keep in mind about the intersection over union formulation which is given by **IoU = Area of overlap / area of union.**

## Physical health analysis

Since we are concerned only with the physical aspect of a human body we have done a short analysis on body mass Index (BMI) which is revised Consensus Body Mass Indices from different regions of India. We will also be calculating BMI along with how much weight a person has to gain or lose to stay healthy irrespective of its diet.

According to world health organization, BMI for men is divided into several categories which are given in figure 2. In the table weights are classified with different BMI ranges, viz. below 18.5 is underweight, 18.5-24.9 is normal weight, and 25.0-29.9 is pre-Obesity state, 30-34.9 is obesity class 1, 35-39.9 is obesity class II and above 40 is obesity class III which sometimes has the risk of death. Similarly for women, the BMI categorization is almost same.

| BMI | Nutritional status |
|---|---|
| Below 18.5 | Underweight |
| 18.5–24.9 | Normal weight |
| 25.0–29.9 | Pre-obesity |
| 30.0–34.9 | Obesity class I |
| 35.0–39.9 | Obesity class II |
| Above 40 | Obesity class III |

Fig.2. Table for BMI categorization

We have taken few states such as Dehradun, Orissa, Rajasthan, and Madhya Pradesh for our consideration having the required data for our analysis.

*Analysis of various states*

We have taken data for various which are shown below:

*Dataset of various states*

**Table 1. Dataset having BMI and BMI category for the state of Orissa.**

| Sex | Age | Height in cm | length in meters | weight in kg | length in meter square | BMI (kg/m2) | BMI category |
|---|---|---|---|---|---|---|---|
| Male | 10 | 120.4 | 1.204 | 22 | 1.449616 | 15.17643 | underweight |
| Male | 50 | 159.8 | 1.598 | 44 | 2.553604 | 17.23055 | underweight |
| Male | 45 | 169.5 | 1.695 | 46 | 2.873025 | 16.011 | underweight |
| Male | 42 | 170.1 | 1.701 | 47 | 2.893401 | 16.24386 | underweight |
| Male | 40 | 153.1 | 1.531 | 43 | 2.343961 | 18.34501 | underweight |
| Male | 39 | 153.2 | 1.532 | 42 | 2.347024 | 17.895 | underweight |
| Male | 10 | 132.8 | 1.328 | 19 | 1.763584 | 10.77352 | underweight |
| Male | 22 | 173 | 1.73 | 52 | 2.9929 | 17.37445 | underweight |
| Male | 85 | 150.3 | 1.503 | 39 | 2.259009 | 17.26421 | underweight |

**Table 2. Dataset having BMI of Dehradun**

| Sex | Age | Length height cm | length in meters | weight in kg | length in meter square | BMI (kg/m2) |
|---|---|---|---|---|---|---|
| Male | 1 | 63.1 | 0.631 | 6 | 0.398161 | 15.06928 |
| Male | 3 | 58.3 | 0.583 | 6 | 0.339889 | 17.65282 |
| Male | 3 | 57.7 | 0.577 | 6 | 0.332929 | 18.02186 |
| Female | 4 | 57 | 0.57 | 6 | 0.3249 | 18.46722 |
| Female | 7 | 72.3 | 0.723 | 7 | 0.522729 | 13.39126 |
| Male | 9 | 72.8 | 0.728 | 9 | 0.529984 | 16.98164 |
| Female | 9 | 71 | 0.71 | 8 | 0.5041 | 15.86987 |
| Male | 1 | 68.2 | 0.682 | 7 | 0.465124 | 15.04975 |
| Female | 11 | 74 | 0.74 | 8 | 0.5476 | 14.6092 |

**Table 3. Dataset having BMI of Rajasthan**

| Sex | Age | length in meters | weight in kg | length in meter square | BMI (kg/m2) |
|---|---|---|---|---|---|
| Male | 10 | 1.356 | 28 | 1.838736 | 15.22785 |
| Male | 15 | 1.541 | 34 | 2.374681 | 14.31771 |
| Female | 35 | 1.732 | 49 | 2.999824 | 16.33429 |
| Female | 35 | 1.661 | 46 | 2.758921 | 16.67318 |
| Male | 15 | 1.541 | 36 | 2.374681 | 15.15993 |
| Male | 17 | 1.721 | 46 | 2.961841 | 15.53088 |
| Male | 38 | 1.737 | 56 | 3.017169 | 18.56045 |
| Male | 22 | 1.639 | 58 | 2.686321 | 21.59087 |

**Table 4. Dataset having BMI of Madhya Pradesh**

| Sex | Age | length in meters | weight in kg | length in meter_square | BMI (kg/m2) |
|---|---|---|---|---|---|
| Male | 8 | 0.603 | 7 | 0.363609 | 19.25145 |
| Male | 8 | 0.621 | 7 | 0.385641 | 18.1516 |
| Male | 9 | 0.623 | 7 | 0.388129 | 18.03524 |
| Male | 9 | 0.604 | 7 | 0.364816 | 19.18775 |
| Male | 9 | 0.623 | 7 | 0.388129 | 18.03524 |
| Male | 10 | 0.649 | 7 | 0.421201 | 16.61914 |
| Female | 11 | 0.639 | 7 | 0.408321 | 17.14337 |
| Female | 11 | 0.64 | 7 | 0.4096 | 17.08984 |
| Female | 11 | 0.641 | 7 | 0.410881 | 17.03656 |

We are taking the BMI of both male and female. After the data cleaning and manipulation we got the graph for number of males and females in the state that we have taken in account. The data provided above is latest data as on 2015.

*Orissa*

We have seen that the number of females is greater than number of males. Both male and female underweight is large in number. Also normal weight of female is greater than male. On the other hand, obesity ratio of female is also greater than male.

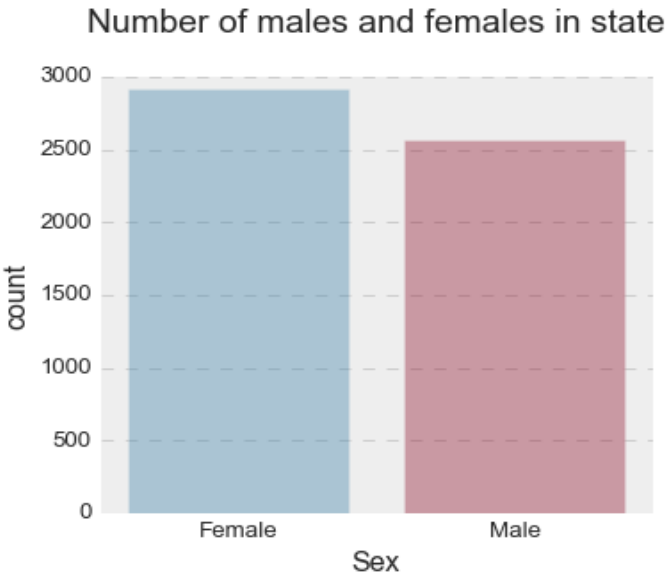


Fig.3. Graph for number of male and female in state of Orissa

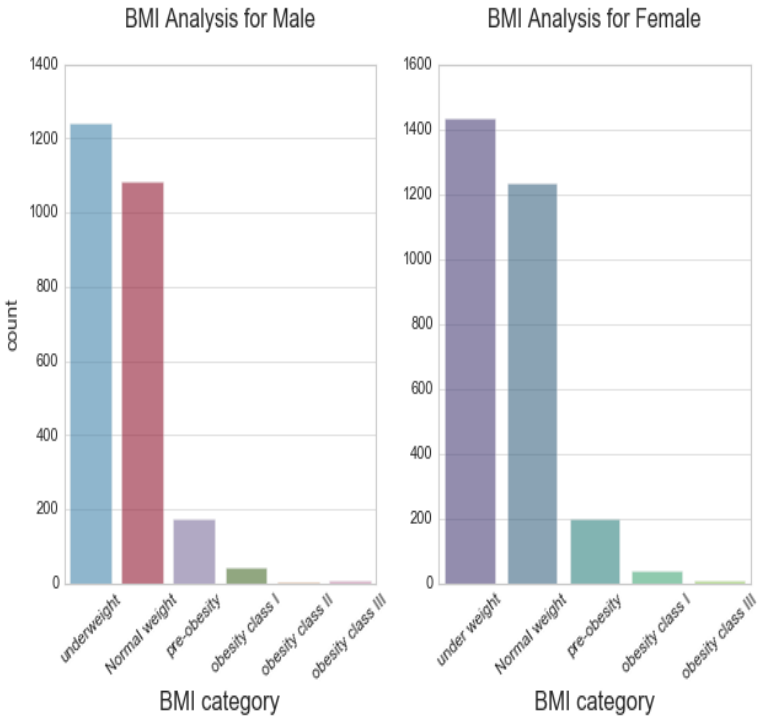


Fig.4. Subplots for BMI analysis of both male and female

*Madhya Pradesh*

Here the number of males is greater than number of females. Underweight males are superior to females. On the other

hand females occupy the top position in normal weight as well as obesity

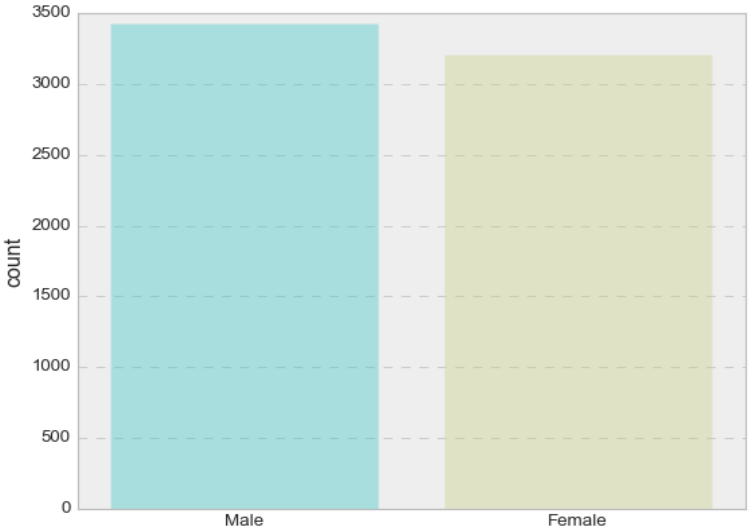


Fig.5. Graph showing number of males and females in the state

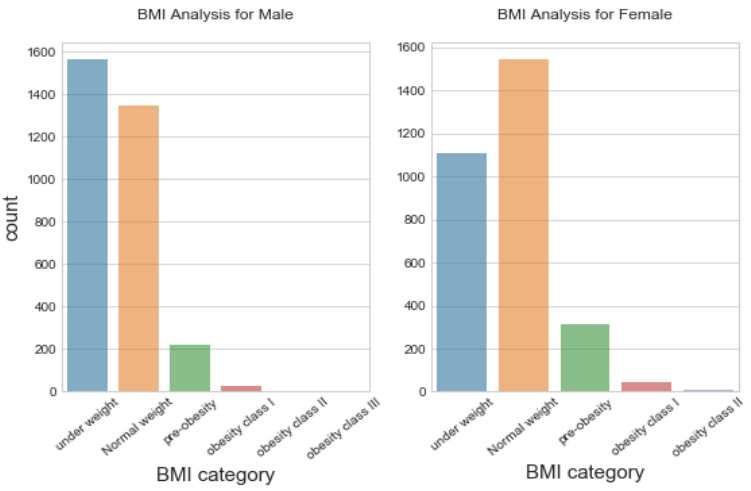


Fig.6. BMI analysis for men and women

## *Uttarakhand*

Here the females have dominated over men. Underweight female are less than men. Also normal weight female are more than men. On the other hand there is also a back view where the females after certain age are more obese than men.

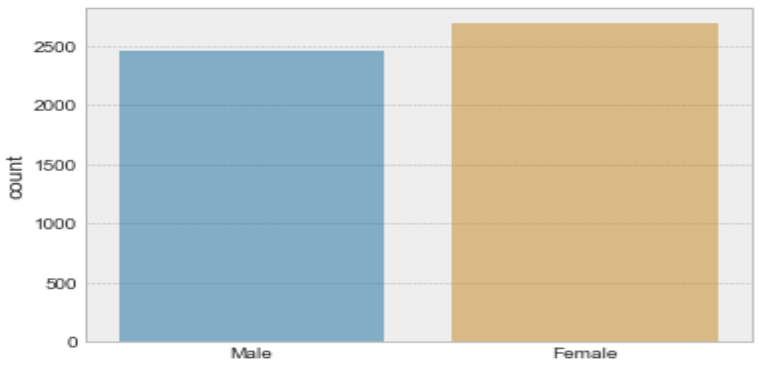


Fig.7. Graph for male to female ratio in state of Uttarakhand

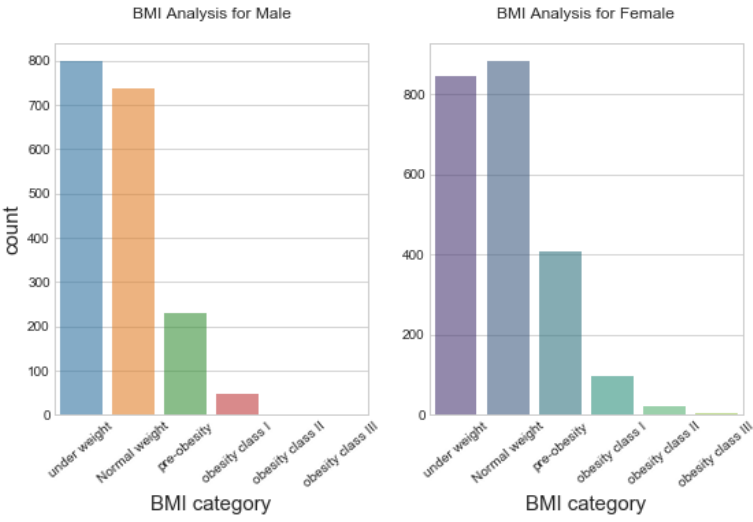


Fig.8. BMI analysis for men and women in the state of Uttarakhand

## *Rajasthan*

Since it is a male dominated state, male are subject to more under weighted than women. Both men and women share the same stat for normal weight. On the darker side females are subject to more obese than men.

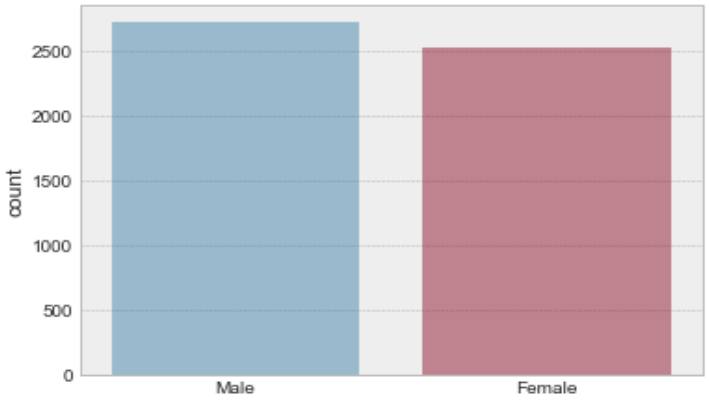


Fig.9. Graph for male to female ratio

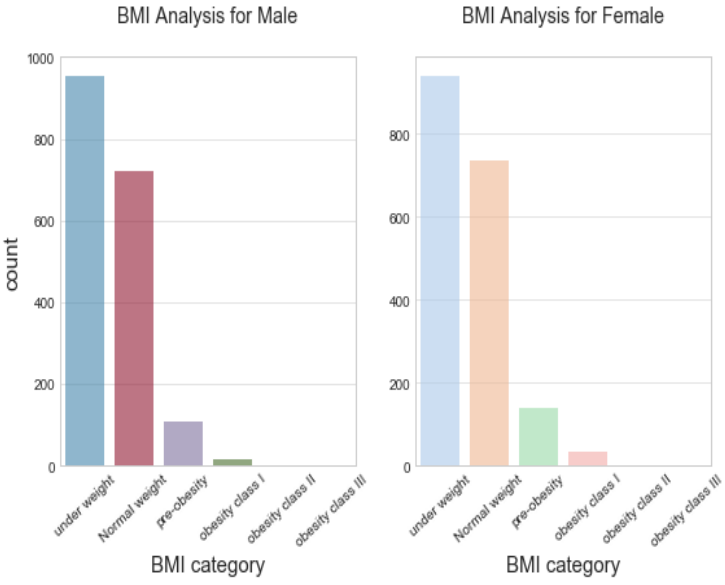


Fig.10. BMI analysis for male and female for the state of Rajasthan

## Advantages

As there is a growing concern for physical health this process will help many people to stay fit. Since it will help every day, the wrong postures will be corrected every day. Apart from young people it will also help old people to control their postural deformities such as spondylitis, arthritis etc. the bigger advantage of this entire setup is that it doesn't require internet connection to rely upon. It has to be started once and it will work of its own.

At beginning level if it helps few people, in long run it will help the whole community. Moreover for this entire setup there is no need for high resolution camera. It is also extremely cost effective. If there occurs any bug, it can be fixed easily.

## Disadvantage

Its only disadvantage is, its time required to get trained in the initial phase. Once trained it doesn't require any further training and can be used at any point of time. In future if we have a very large amount of data then high computational GPU's are required otherwise it can work on normal systems also. Moreover cloud platforms are also available for further computation.

## Future scope

Since we are trying to get much accuracy in case of SVM and masked R-CNN, more images will help in attaining the best accuracy. We are trying to train our network in every possible way so that it can detect many postures without any delay. Also we are trying to deploy our model into cloud using AWS so that it can reach out globally. Moreover it can be used to assimilate with smart appliances and internet of things for various control mechanism.

## Conclusion

Since we are in early stages of development, once done it will serve the humankind in every possible way. In our earlier days people used to be fit and healthy due to which their life span was more than the present estimated life span. There are people in the world whose age is more than or equal to hundred. That was because of their fitness and diet. In our day to day world we are so busy that we don't even think about our own health. Children now a days are mostly prone to smart phone syndrome. To control these harmful ill effects, we tried to come up with the idea where a person uses the technology but to make themselves fit.

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