Deep Face Recognition
Estimating Body Mass Index

Submitted in the partial fulfillment for the award of the degree of

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IN

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DECLARATION

We Aditya Gupta, Bhagath Reddy, Chirag students of **'Bachelor of Engineering in CSE AI&ML'** Department of Computer Science and Engineering, Chandigarh University, Punjab, hereby declare that the work presented in this report entitled '**Deep Face Recognition Estimating BMI'** is the outcome of our own bona fide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics. It contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or institute of higher learning , except where due acknowledgment has been made in the text.

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Abstract

By using the image of user's face and try to estimate the BMI(Body Mass Index), Age and Gender of the person. Convolution neural network for estimating "Body Mass Index" of a person from the their facial image

Training multiple regression models to finding out the best one a novel approach for estimating BMI and A developed a Web Application for the same to dynamically detect face using webcam or uploading image., predicting BMI in this way could be a useful tool in medical diagnostics.

Being a Computer Science Student we keep learning practical real word problems solving to gain knowledge and experience to the best as possible.
Thankful for having this project

Acknowledgement

The satisfaction along with successful completion of project will be incomplete without the mentioning of people who made this possible without the support, hope and guidance it may not be possible, we are privileged to express our gratitude & respect for those all those who guided us for the project.

*We are thankful for our project guide **Shifali Sharma** of Computer Science Department for providing constant guidance ,suppot that served a great help in this project*

*We wish to thank our **parents** for their never ending support and providing this opportunity to study engineering*

1 INTRODUCTION

1.1Problem Definition:

The majority of people don't know how to calculate BMI or either find it too difficult to calculate their BMI daily and don't know whether their BMI is healthy or not.

A lot of health problems can arise when a person is obese, if a person can estimate their BMI by simply upload their photo and they will know their health conditions and help them to become healthy.

1.2 Project Overview/Specifications:

Together using a person's gender, age and weight stats, that can influence on many aspects of their life. It can affect their health as having a high BMI is linked to increased risk of both cardio stroke and diabetes

The human face exhibits information pertaining to identity, a person's disposition, as well as attributes such as gender, age and ethnicity. Biometric emphasis has predominantly been placed on facial recognition.

The attributes such as gender, age, height and weight gaining popularity due to semantic interpretation, like they can show you description which can understandable for people example, describing -old, -male, -short.

The BMI prediction system composes of two stages:

1. Deep feature extraction and training a regression model.
   For feature extraction using VGG-Net, trained on general object classification, VGG-Face, trained on a face-recognition task for the BMI regression, the support vector-regression models linear regression in feature space.
2. Training regression models and finding out the best one a novel approach to estimate height, weight and BMI from single- shot facial images and a Web Application

   To identify the age and gender of a person using the input of their face
   To find BMI of the person from height and weights of a trained model to detect a user's face with their webcam

In this train data used were 4000 images, here BMI of each training sample was calculated from the subject's height and weight (BMI is weight in kg divided by the squared height in meters),Google Face-Recognition library, ResNet-34 and VIP attribute Dataset consisting of 1026 subjects, specifically 513 female and 513 male celebrities

1.3 Hardware Specification:

- Processor: Intel i3 or above
- Memory: 2 GB RAM or above

1.4 Software Specification:

- Operating System: Windows 7 & above
- Google Colab
- Anaconda- Jupyter notebook
  Libraries:
  pandas ,Keras ,scipy, matplotlib, opencv_python ,numpy, tqdm, keras_vggface mtcnn,Pillow ,scikit_learn, tensorflow,ResNet-34

2 LITERATURE REVIEW

2.1 Related Work

The study explored various related works for face based BMI calculation Some of the methods used for the estimation of BMI are normalizing, and face fitting, geometric based fitting and ratio features that were completed using cheekbone to jaw width, face width to upper facial height, perimeter to area , eye size, lower face to face height ratio, face width to lower face height these are been normalized and supported with vector regression.

2.2 Proposed Work

Here we had a novel approach to find BMI by mapping a face feature vector by taking new facial features in to account are "Facial height , Facial nose height, Lips width, Color , Gender" , thankfully VIP_Attribute Dataset has provided the data for the completion of work containing the given attributes

These detected faces are provided as input to regression models

Train various regression models to find out the best model.
Used face recognition library ResNet-34 but with fewer layers and half the number of filters were been used

Created a Web Application model for a person to estimate their BMI simply by uploading their photo, they will be able to know about their health conditions and focus on their health

2.3Feasible Study

Benefits of Face to BMI:

In the Medical Field many illnesses can be predicted beforehand and can be alerted to the concerned person about the health issues they might have to face due to their excess weight. Obesity is a major issue in the society these days and if people get to know that they are obese, this alerts them and they might focus on their health thus decreases their risk

As a Marketing strategy.

Gyms, Fitness applications and trainers can use it as a marketing strategy. On Social Media profiles they can promote the specific users to check BMI simply by loading their image and if the BMI is not in the healthy range, they can alert the customer about the problems they might have to face due to excess weight

Tell them to join their Gym or take their health and fitness apps so that they can live a healthy lifestyle!

BMI Calculation

We can calculate body mass index using the height and weight of a person

- BMI = kg/m2 where i.e. weight/height^2
- If BMI give a value of 25 and more he/she is considered overweight
- Normally a healthy BMI range lies between 18.5 to 24.9
- BMI can apply to most adults from 18-65 years.

Who shouldn't use a BMI calculator

We do not recommended to check for BMI to following

BMI is not for muscle builders, athletes, pregnant women, young children. And for children as their muscles a not fully grown
During pregnancy woman's body changes,

3 PROBLEM FORMULATION

3.1:***Preprocessing:***

Input preprocessing pipeline:
loads image to resize and convert an array to create
feature model labeling BMI, Age, Gender
create models for random sample which generate fitting models

3.2: ***MTCNN face detector (MTCNN):***

alignment: train data to crop face and
detect faces to make predictions

3.3:*VGGFace face prediction (VGGFace*):

with transfer learning and VGG16 multi tasking to
learn multiple tasks here we combine 3 tasks together
from keras

3.4:Face Detection:

Face detection is done by using `MTCNN`, which is able to detect multiple faces within an image and draw the bounding box for each face.

MTCNN:

1. Preprocess and align the facial features of the image.
   image is preprocessed by `MTCNN` to extract faces and crop images on the face.crop images are saved in the model .

2. Enable prediction for multiple persons in the same image.

Keras-VGG face

Oxford VGGFace using Keras Functional Framework :

- supports only the Tensorflow backend.
- loads only feature extraction layers with VGGFace initiation.

The model architecture:

- Convolution + ReLU activations
- MaxPooling
- softmax

3.5 Training regression models and finding out the best one.

Using python face recognition library i.e. ResNet-34 but here used a less layers also the no of filters reduced to half.

Map a face image into a feature vector

Considering various Features like :

- Facial-Height
- Facial Width
- Color
- Lips width,
- Nose height

These detected faces are provided as input to regression models.

- Simple Linear Regression
- Ridge Linear Regression
- Random Forest Regressor
- Random Forest with tuned hyper parameter
- Kernel ridge regression

3.6 *Web application:*

Using anvil platform to connect python notebook to upload image to test and call the trained model to predict and display

4.Methodology:

In CNN convolution blocks are followed by the dense layers to make prediction. In naive model the 3 models are required to train separately, increasing maintenance cost

[“[input img] -> [VGG16] -> [dense-layers] -> [BMI]”]

[“[input img] -> [VGG16] -> [dense-layers] -> [Age]”]

[“[input img] -> [VGG16] -> [dense-layers] -> [Sex]”]

Here as we are predicting different attributes (BMI, age, sex) on the same input image,

we can combine and create a single model for the three

{[input img] -> [VGG16] -> 3*[separate-dense-layers] -> weighted([BMI], [Age], [Sex])}

A Deep Relationship Network with convolutional and task-specific fully connected layers with matrix priors

The most simplified multi-task learning structure,

Deep Network with shared convolutional and task-specific fully connected layers with matrix priors VGG-Face,is used as feature extractor to extract the activation vector of the fully connected layer in the CNN architecture.

We approached the problem by observing performing of various loss functions:

Here we had a novel approach to find BMI by mapping a face feature vector by taking new facial features in to account are
“Facial height , Facial nose ,height, Lips width, Color , Gender”
Thankfully VIP_Attribute Dataset has provided the data for the completion of work containing the given attributes

These detected faces are provided as input to regression models

Train various regression models to find out the best model.

- Simple Linear Regression: simple linear equation y=wx+b, we can calculate MSE as:

$$MSE = 1/N \sum (yi - (w.xi + b))^2$$

- Ridge Linear Regression: adds a penalty for large variations in w parameters.

$$RIDGE = 1/N \sum (yi - (w.xi + b))\ 2 + \lambda \sum wj$$

- Random Forest Regressor: It is trained on a specific sample and its output depends on multiple decision-Trees.

$$Cost = sum\ (y - prediction)^2$$

- Kernel ridge regression: combine both Ridge-regression and Classification

5: CONCLUSION

It was found that Random Forest Regressor with tuned hyper parameters outperformed all the models in terms of the mean squared error and explained variance.

BMI can be experimentally verified from the predicted height and weight as: BMI = weight [kg] / height^2 [m^2]

This project presented a novel approach for estimating height, weight and BMI from single- shot facial images,

based on regress ion models. Experiments conducted on the dataset, resulted in absolute mean error of 0.083

and variance score of 0.43.

6. FUTURE SCOPE

We did not observe a significant gender-bias in estimating height, weight

and BMI. However, more work is necessary in this regard.

Future work will involve the additional study of age and ethnicity in order to improve utilization of facial appearance

for height, weight and BMI estimation.

The web applications can be useful for Gyms,Fitness Trainers and Fitness Apps can use this as their marketing strategy.

They can prompt the potential customers to check their BMI by loading their image and alert the customer about

the problems they might have to face due to excess weight and inspire them to join

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8 TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

1: INTRODUCTION

This Project is to estimate BMI, age and gender of a person using the input of their face, which include the weights of trained model. Training multiple regression models to finding out the best one a novel approach for estimating BMI and A developed a Web Application for the same to dynamically detect face using webcam or uploading image detect a user's face with their webcam., predicting BMI in this way could be a useful tool in medical diagnostics.

2: LITERATURE REVIEW

To find BMI of the person from height and weight help full to make aware of their body fitness also can be used as medical diagnosis tool which has benefits in the Medical Field to fight Obesity it is a major issue these days and if people get to know that they are obese ,this alert them to decrease their risk and can also used as a Marketing strategies for Fitness Trainers and Fitness Apps can use and can advise them to join their Gym or take their health and fitness apps so that they can live a healthy lifestyle

Not everyone should use a BMI calculator
BMI is not used for muscle builders, pregnant women, the elderly or young children.

3: BACKGROUND OF PROPOSED METHOD

In this we will provide introduction to the concepts that are necessary for understanding the proposed work.

4: METHODOLOGY

Face detection is using `MTCNN`, which is able to detect multiple faces within an image and draw the bounding box for each face.
VGG, Keras
New facial attributes considering
The detected faces are provided as input to regression models
Train various regression models to find out the best model

5: EXPERIMENTAL SETUP

The basic setup required for the complete functioning of this project on a PC is a perfectly working Anaconda/Jupyter Notebook/ colab using google gpu.

6: RESULTS AND DISCUSSION

The result will be based on the input provided.