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Face to BMI (Body Mass Index) Using Deep Learning

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ABSTRACT: A person's body mass index (BMI) is a measure of their health condition in proportion to their weight. A number of variables have been linked, including body mass index, level of fame, and state of mind and physical health. A person can be learned numerous things just by looking at their face. It's essential to consider all factors when assessing an individual's overall health. Paying attention to subtle cues in the face could provide valuable insights into a person's well-being. The connection between BMI and facial features is a complex and intriguing field of study that continues to evolve. By exploring this relationship further, we may uncover valuable information that can help improve our understanding of health and well-being. Human labour is usually necessary for body mass index (BMI) computations since they ask for exact measurements of height, weight and body mass index. Businesses and governments may automate BMI calculations on a large scale to study society in its whole and make better judgments. Previous research has either relied solely on geometric face traits, ignoring contextual cues, or relied on data driven deep learning, which can create a bottleneck when dealing with large datasets. Using a giant public dataset that allowed discriminative learning, we enhanced many state-of-the-art pre-trained models, including Exception, VGG-Faces, VGG19, and Inception-v3. For training, we used the bigger Illinois DOC labelled faces dataset, and for assessment, we used the Arrest Records, VIP attribute.

KEYWORDS : Body Mass Index(BMI) , Deep Learning, Overweight, Underweight, Facial feature prediction, Ridge Regression, Convolutional Neural Network(CNN).

I. INTRODUCTION

An essential measure of health is the Body Mass Index (BMI) of every individual. This establishes whether the person is normal weight, overweight, obese, or underweight. In our current situation, health is one of those things that get the very least attention. Technology offers numerous advantages, but also contains numerous disadvantages. This has led to people becoming more sedentary; subsequently increasing their body mass index (BMI) and reducing their level of physical exercise. All these factors contribute to making individuals more unwell and more prone to developing chronic illnesses. Heart disease and other major conditions are made more likely by a high body mass index (BMI). However, many individuals struggle with problems like malnutrition and undernourishment as well. Consequently, body mass index (BMI) is a tool that is helpful in monitoring one's health status. It is estimated that by 2030, around 20% of the global populace will be overweight, and approximately one-third of adults are currently overweight[1].

Body Mass Index (BMI) is a frequently utilized index that applies the ratio of an individual's height to weight to indicate their general body mass status. There are numerous facets connected to BMI, including physical health, mental health, and popularity. The calculations of BMI often necessitate precise measurements of height and weight, which include labour-intensive manual labour. Simply by looking at someone, one may get a sense of who they could be. Recent studies have revealed a strong connection between a person's appearance and their body mass index (BMI). People with more petite faces frequently also have lower body mass indexes. Overweight individuals typically have wider features in the middle and lower parts of their face.

It can be quite challenging for a person to determine their body mass index (BMI) in the absence of both a scale and a measuring tape. With the most recent advancements in deep learning, models can now derive valuable data from facial photographs [2]. These techniques can be applied to determine a person's body mass index (BMI) based on their facial features. Therefore, a method has been introduced in this study that allows for the prediction of body mass index (BMI) using facial images [3] features. Health insurance companies may find it easier to maintain consumer

health data with this technique. Moreover, the government can observe regional health statistics and make necessary legislative adjustments accordingly

II. RELATED WORKS

In the recent years, the rising concern about obesity trends has sparked a demand for more personalized health assessment tools. By analyzing facial features via AI technology, it is possible to estimate an individual's BMI with accuracy. This research has compared five different deep learning models like VGG, ResNet50, DenseNet, lightCNN .

Estimation of Body Mass Index from Face Images Using Convolutional Neural Networks:

This research proposed a novel method leveraging convolutional neural networks (CNNs) to estimate BMI directly from facial images. The study utilized a large-scale dataset of facial images paired with corresponding BMI values. By training a CNN model on this dataset, the researchers aimed to capture complex facial features indicative of body composition. The CNN learned hierarchical representations of facial features, enabling accurate BMI estimation. Evaluation results demonstrated the effectiveness of the proposed approach in estimating BMI from facial images with high precision.

Estimating Body Mass Index from ResNet50 with Deep Learning:

A ResNet architecture model called as ResNet50 is used as a predictor to estimate the age, gender of a facial image. This ResNet50 model is based on Deeper Neural Networks. A residual networks of depth 152 layers is applied on ImageNet dataset to fine tune the model.

Facial BMI Estimation: A Transfer Learning Approach:

Introduced a transfer learning approach for facial BMI estimation, which leveraged pre-trained deep learning models on large-scale face datasets. The researchers fine-tuned the pre-trained models on a smaller dataset specifically curated for BMI prediction tasks. By adapting the learned representations to the target domain, the transfer learning approach aimed to enhance the generalization and robustness of facial BMI estimation models. The study demonstrated the effectiveness of transfer learning in improving BMI estimation accuracy, particularly when faced with limited training data. This approach highlighted the potential for leveraging pre-trained models to address challenges in facial BMI estimation, such as dataset scarcity and model overfitting (ANNs), calculated relapse, choice trees and backing vector machines (SVMs) can be utilized to play out the order task with moderate success.

III. PROPOSED WORK

The suggested technique calculates body mass index[4] by examining facial characteristics with convolutional neural networks (CNNs) written in Python. CNN takes a picture as input, finds the face traits in it, and then utilizes those features to calculate a person's body mass index.

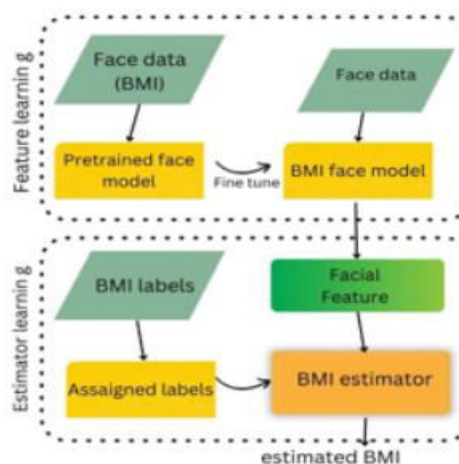


Fig-1 Flowchart

3.1 Input Image :

The front-facing image from the dataset is utilised as the input and put up to the application.

3.2 Face Detection:

The facial detection BMI detection CNN model are loaded by the face detection module. When a human facial features are detected in an image which is in the dataset , facial features are added to the CNN model to forecast BMI.

3.3 Aligning the BMI Labels:

The task of this BMI labels module is to analyze the characteristics of the face. If in case the input looks blurry or slightly off-kilter, for instance, the image is slightly zoomed in and aligned to undergo preprocessing using the StyleGan technique!! and the DLIB 68 landmark model.

3.4 Facial Feature Extraction :

The process involves inputting data into a pretrained CNN, extracting the activation values, and leveraging regression for deep feature extraction. Despite some challenges, the outcomes are crucial for further analysis and optimization

3.5 Predicting the BMI:

The face is being extracted from the provided input image in this final module, and the features are being analysed, as indicated in the earlier modules, to finally forecast the BMI!! The estimated BMI can be used to quickly determine if a particular individual is overweight or underweight.

3.6 CNN architecture

CNN (Convolutional Neural Network) are a certain type of neural networks that are extremely helpful for solving problems related to computer vision. They took inspiration from how our brains process vision, specifically in the visual cortex. They rely on a filter/kernel to sift through all the pixel values in an image and perform calculations by providing proper weights to facilitate detection of particular features. The CNN is composed of several layers including convolution layer, max pooling layer, flatten layer, dense layer, dropout layer, and a fully connected neural network layer. These layers collectively create a potent tool capable of recognizing features in an image. The initial layers spot low-level features which progress to identifying progressively more complex higher-level features. Unlike traditional Neural Networks, CNN layers organize neurons into 3 dimensions: width, height, and depth. The neurons within a layer only connect with a small section of the previous layer (window size) rather than all neurons in a fully-connected way. Furthermore, the ultimate output layer will have dimensions (number of classes), since at the end of the CNN architecture, we compress the entire image into a solo vector of class scores.

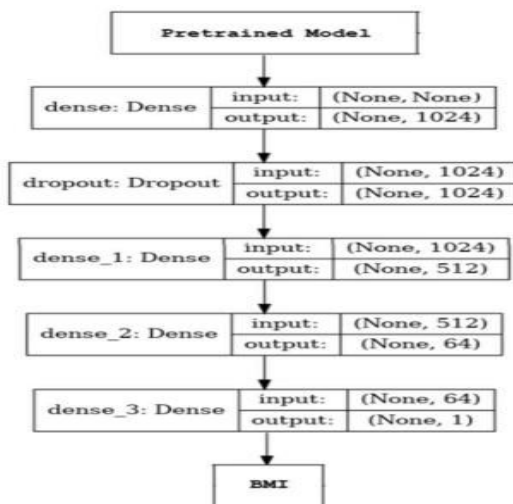


Fig-2 System Architecture

IV. RESULTS AND DISCUSSION

4.1 Dataset

This Dataset is collected from Kaggle dataset is focused to estimate the BMI based on the Gender, Height & Weight. This paper shows that face can be an important estimator of your height and weight and hence the BMI. The dataset consists images of celebrities. The images that has been taken is downloaded using google search engine results.

Number of rows and columns: 226 rows, 7 columns

4.2 Results

The advantages of the proposed system clearly outweigh the design, model and therefore the challenges of the existing system. Previously the faces taken as input are not aligned to centre, but in the proposed system any titled, blur or distorted, inconsistent images can also be classified thus gradually reducing time and enhancing performance. Active shape model was largely used in the pre existing system, but this has been eliminated by using preprocessing techniques such as StyleGAN technique which makes the inconsistent images similar then DLIB 68 Landmark model comes into picture which aligns, zooms in and blurs the surroundings while focusing on the face. The models trained for the prediction of BMI in the proposed system which are VGG-Face, Inception-v3, VG-19 and Xception give the proposed system a huge advantage over the existing system since the mentioned models use Convolutional Neural Networks with numerous layers while each being unique and support different functionality by applying the latest developments in deep learning therefore helping in efficient calculation and better accuracy of the individual's BMI.

Image	Gender	Predicted BMI	Actual BMI
vikky	Male	31.47	23.67
hema	Female	27.67	24.83
jaya	Female	33.90	24.55
amit	Male	21.33	23.01
rampal	Male	17.68	23.24
abhishek	Male	21.9	25.70
mandira	Female	31.78	22.12
aamir	Male	37.86	26.65

Table 1: Comparison Between Actual And Predicted BMI

Here are some test cases Screenshots:

```

test_image = 'height_weight_test/vikky1.jpg'
Image(test_image)
✓ 0.0s Python

```



```

predict_height_width_BMI(test_image,height_model,weight_model,bmi_model)
✓ 0.6s Python
height_weight_test/vikky1.jpg
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:3: DeprecationWarning: np.asscalar(a) is deprecated since
This is separate from the ipykernel package so we can avoid doing imports until
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:4: DeprecationWarning: np.asscalar(a) is deprecated since
after removing the cwd from sys.path.
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:5: DeprecationWarning: np.asscalar(a) is deprecated since
"""
{'height': 1.8246074598857358,
'weight': 78.80585351506673,
'bmi': 23.67116238878474}

```

Fig-3 Sample Output-1

```
test_image = 'height_weight_test/hema1.jpg'  
Image(test_image)
```

✓ 0.0s Python



```
predict_height_width_BMI(test_image,height_model,weight_model,bmi_model)
```

✓ 0.5s Python

```
height_weight_test/hema1.jpg  
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:3: DeprecationWarning: np.asscalar(a) is deprecated since  
This is separate from the ipykernel package so we can avoid doing imports until  
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:4: DeprecationWarning: np.asscalar(a) is deprecated since  
after removing the cwd from sys.path.  
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:5: DeprecationWarning: np.asscalar(a) is deprecated since  
.....
```

```
{'height': 1.6592537172883568,  
'weight': 68.36748371751045,  
'bmi': 24.832703168160883}
```

Fig-4 Sample Output-2

```
test_image = 'height_weight_test/rampal2.jpg'  
Image(test_image)
```

✓ 0.0s Python



```
predict_height_width_BMI(test_image,height_model,weight_model,bmi_model)
✓ 0.5s Python

height_weight_test/rampal2.jpg
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:3: DeprecationWarning: np.asscalar(a) is deprecated since
This is separate from the ipykernel package so we can avoid doing imports until
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:4: DeprecationWarning: np.asscalar(a) is deprecated since
after removing the cwd from sys.path.
c:\Users\DELL\AppData\Local\Programs\Python\Python37\lib\site-packages\ipykernel_launcher.py:5: DeprecationWarning: np.asscalar(a) is deprecated since
****

{'height': 1.8089997019645034,
'weight': 76.06230825244832,
'bmi': 23.243017547499942}
```

Fig-5 Sample Output-3

V. CONCLUSION

It has been suggested that individuals with greater body mass indexes are more likely to experience health complications. A person's body mass index (BMI) and facial features are highly correlated. Hence, a deep learning approach is proposed for estimating BMI using face images[5]. In order to calculate the BMI, the facial characteristics are analyzed using Python's CNN (convolution neural networks) approach. Convolutional neural networks (CNNs) can take an image as input, identify face traits, and use them to determine body mass index (BMI). For the purpose of face centering and pre-processing, the BMI detection method is employed. Subsequent studies will mimic the method., prevalence of obesity in the population as a whole by analyzing photos shared on various social media[6] platforms. It's remarkable how technology can assist in understanding health trends through facial analysis. Overall, this cutting-edge technology introduces innovative ways to evaluate health concerns based on facial inputs. The synergy between technology and healthcare opens new horizons for research and practical applications in the field.

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