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Research Article

METHOD FOR APPLYING BEAUTY EFFECTS SETTINGS BY THE CAMERA THROUGH MACHINE LEARNING

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Abstract

Beauty enhancement in the image become very popular nowadays. Currently, there are various types of modes to apply beauty effects with the help of skin tones and the age of the detected face. In this paper, we propose a novel prediction of the best beauty effect by enhancing the structural quality of the face. Various beauty modes provide brightness change and skin smoothness. There is a neural network method that is used to predict the best output extracted from the image. In this paper, mapping the ratio to the modes provided by the phone convert the shape and structure of the facial features.

Keywords:

INTRODUCTION

Using beauty effects to enhance the image has become very common. There are lots of filters and skin tone changes which are used to apply beauty effects to the face. Some mobile phone providers especially work on the enhancement of the beauty of the face. It uses real calculations of the face which are face height, width, gender, and skin type to enhance the beauty of the face. Here no machine learning is used to detect or enhance the beauty. There is a feature called Samsung auto mode which detects the gender, width, height, and skin tone on a real-time basis which is calculated with the help of an open CV. Similarly, other phones (Vivo, Oppo) also use the same methods to beautify the face in the image. It generally enhances the color tone of the skin. We used the features which are already in the phone and map our algorithm with them to change the size, and structure of the facial features such as nose, eyes, forehead, jaw, etc. with the use of the machine learning algorithm. In order to achieve the beauty effects, we used an unsupervised learning method that takes an image as an input, feature points are detected with the neural network, and also feedback is provided for increasing the accuracy of the beauty effect. The output from the machine learning algorithm

Background

Mobile apps these days use traditional modes for applying beauty effects, they usually take some parameters like face weight, face height, age, gender, skin tone, and different ratios from our face (values are fixed from the beginning). They also took more time in preprocessing, as they had to determine age, gender, height, and width. They do not enhance the structural quality of the user's face. Their accuracy is limited to 70-75%. They do not use machine learning to enhance the user experience by giving a better result by enhancing the structural quality of the user's face, thereby reducing abnormalities in facial structure. They use predetermine values for beauty ratios which include Beauty Ratio mapped to Nose Reshape mode,

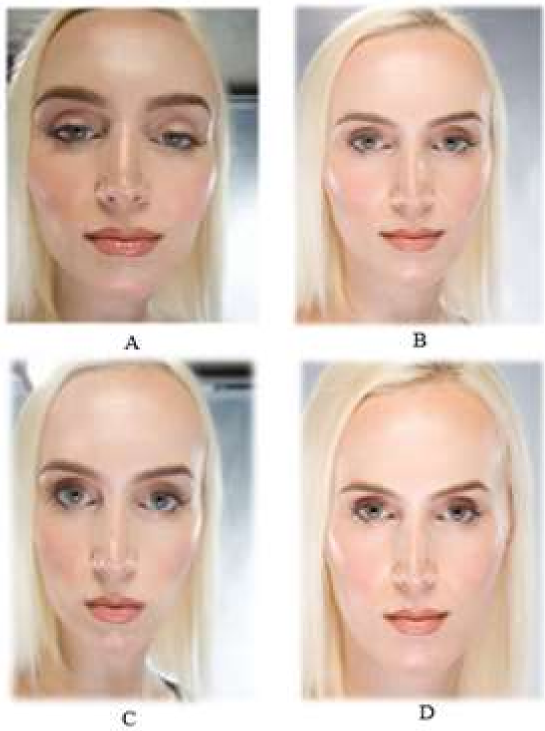

Fig. 1. It shows the input image (a) and comparison with Samsung auto mode (b) with skin tone enhancement and other phones (c) with the age detection to reduce the face skin aging and then last ours (d) where the facial structure and the skin tone.

Beauty Ratio mapped to "Forehead" mode, Standard Beauty Ratio mapped to "jaw" mode, and Standard Beauty Ratio mapped to thin nose mode. Given that fixed ratios are.

- (3:5) is the ratio of the Vertical distance between the top of the face and nose to the vertical distance between the nostrils and the tip of the chin
- (5:8) is the ratio of the Vertical distance between nostrils and tip of the chin to the vertical distance between pupils and nostrils
- (8:9) is the ratio of the Vertical distance between pupils and nostrils to the vertical distance between nostrils and central lip line.

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- (2:4) Vertical distance between pupils and tip of the chin to vertical distance the between top of the face and pupils
- (3:5) is the ratio of the Vertical distance between the top of the face and nose to the vertical distance between the nostrils and the tip of the chin
- (6:7) is the ratio of the Vertical distance between pupils and central lip line to the vertical distance between lips and tip of the chin.
- (8:9) is the ratio of the Vertical distance between pupils and nostrils to the vertical distance between nostrils and central lip line.
- (7:9)the is ratio of the Vertical distance between lips and tip of the chin to the vertical distance between nostrils and central lip line
- Ratio of Smile width to nose width – 1.619
- Ratio of Nose width to the inner edge of nostril – 1.624

METHODOLOGY

As discussed earlier, the main idea behind the AI beauty algorithm is to map the different beauty effects to predict the best facial structure along with the enhancement in skin tones. It finds the beauty ratio according to the face, which includes vertical and horizontal beauty ratios. After the findings of the beauty ratios, it superimposes the curve to the beauty ratio curve which is known by the camera beauty effects. After that, it predicts the best beauty effect which also changes the facial structure of the image too, if required.

Image Analysis

Face detection is the first step, where the face and non-face pixels get separated as by training the data sets with manual labeling of face pixels and the non-face pixels. It used RGB channels to classify the face in the image as the face pixels have a distinctive range of colors.

Classification of Image

Classifying the image according to its facial structure and the ratios of the facial features such as the distance between chin & pupil to the distance between forehead & pupil, the vertical distance between the pupil & central lip line to the vertical distance between lips & tip of the chin, and so on.

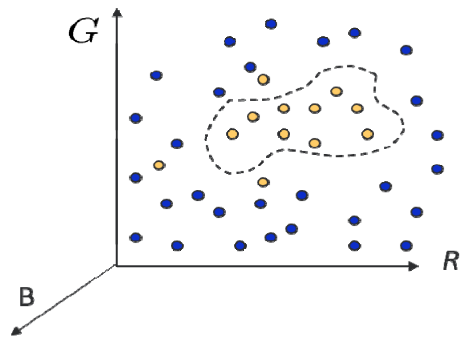


Fig. 2. RGB graph produced from the training set of images. Dots in yellow shows the face pixels while in blue represents non-face pixels

Feature Point Extraction: For the extraction of the features of the face, we have taken the 5 frequencies and 8 different values of the angle 'θ'. Which combined to form the 40 feature points on the face which depicts the important features of the face. Each feature point consist 3 values which resembles the RGB channels of that particular point.

$$f e^{\frac{x^2+y^2}{2\sigma^2}(\cos(2\pi f x+\phi)-\cos\phi\, e^{-2\pi^2\frac{\sigma^2}{f^2}})}$$

Where,
$\sigma = kf$; f is frequency
$x = x\cos\theta + y\sin\theta$
$y = -x\sin\theta + y\cos\theta$

Facial Beauty Ratio: It is the parameter to defines, the beauty values in terms of facial feature parameters. Generally there are three types of beauty ratio namely, Standard Beauty ratio, Vertical Beauty ratio, Horizontal Beauty ratio. The standard ratio value is approximately 1.618, which defines the beauty ratio of the total face. The Vertical and Horizontal ratio are used to precisely define the vertical standard ratio (0.36) and horizontal standard ratio (0.47). These ratio uses the previously obtained feature points to calculate values. Matching the horizontal ratio which includes the eyes from inside to outside corners, the width of nose and inside edge of eyebrows. Let's take an example of positioning of the pupil. The position of the left pupil is 38 pixels and the beauty ratio line at 100 pixels, also position of right pupil is 162 pixels and the beauty ratio line at 224 pixels.

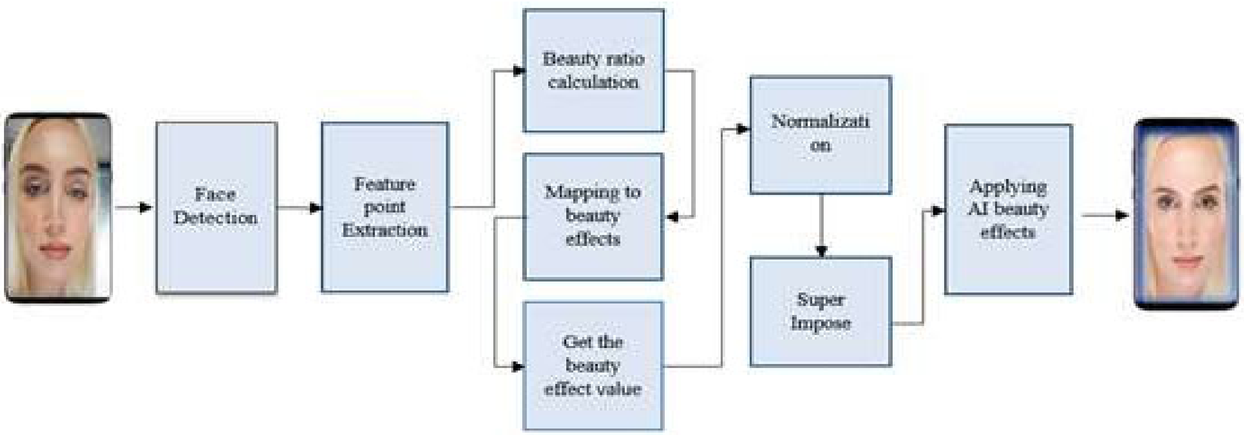


Fig. 3: It represents the flow of the research paper, where input is fed to the algorithm to determine the best beauty effect according to the face shape and the type of person. At first face gets detected on which the further operation like feature point extraction, beauty ratio calculation and mapping is implemented. With the neural network algorithm after normalizing and superimposing the best beauty effect is being predicted.

Table 1. Horizontal Ratio

Dimension	Beauty ratio
Position of left pupil (38)/ beauty ratio line at 100 pixels	(38+100)/2 = 69
Position of right pupil (162)/ beauty ratio line at 224 pixels	(166+224)/2 = 193
Distance between pupil	193-69 = 124
Standard horizontal ratio	124/264 =0.47

Table 2. Vertical Ratio

Dimension	Beauty ratio
Position of eyes at 162 pixels	(38+100)/2 = 69
Position of lips/teeth at 262 pixels	(162 +224)/2 = 193
Distance between the teeth and the chin	262-162 = 100
Height of the hairline at 62 pixels to the chin at 324	324 -62 =262
Standard vertical ratio	100/262 = 0.38

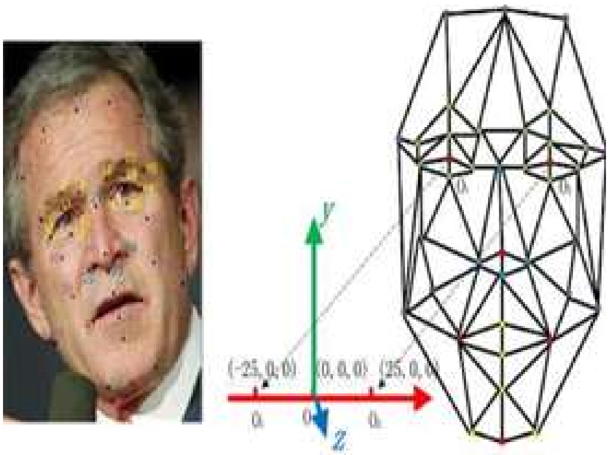


Fig. 4: finding the special feature point of the face with the help of several frequencies and different theta values. These are mostly the points which represents eyes, eye-brows, nose, lips, chin, so on.

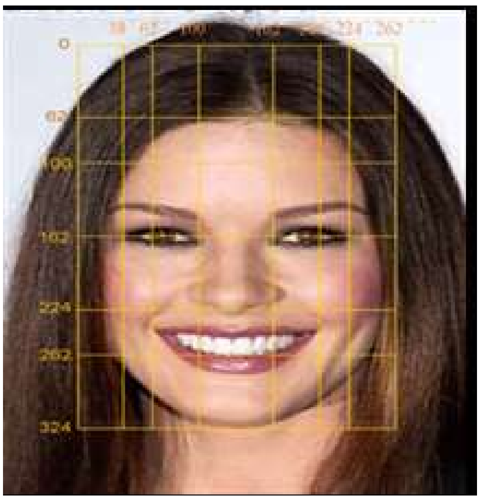


Fig. 5. It shows the horizontal and vertical distance between the various feature points of the face. Here we take an example of the eye with the table 1 as its horizontal ratio calculation and table 2 as its vertical ratio calculations. Through which the standard ratio for the vertical distanced between the eyes from other features is derived and with the horizontal distance, standard ratio between the pupils is derived

Image Mapping to Beauty Effects

There are various effects which enhance the beauty of the face, some considerable effects are slim face, large eyes, shape correction. For each effects several beauty ratio are used, like slim face effect increase or decrease the face width of a person which requires the horizontal and vertical ratios. Large eyes are mapped by increasing or decreasing the distance between eye corners and enlarge the eye pupils according to the face. It uses the horizontal ratio's which are calculated in the previous method. Shape correction is the changing of the facial distances to make a perfect aligned face according to the person.

M(x) = E
Where: M → Mapping function
x → ratio
E → It is the mapped function to the effects as per the component type

Predicting beauty effects

With the mapping function and the beauty ratio, we have enough information regarding the perfect beauty effect prediction. As with these data and the machine learning algorithm we are able to predict the perfect beauty effect for the particular person's face. Soft max is the classifier which is used in the algorithm, let's say we pass 3, which means we want 3 categories to be classified into it. The beauty effects predicted through our trained model are Large eyes (LE), Shape correction (SC), Slim face (SF). This prediction based neural network is created by tensor flow library, in which 4 layers of neural network having 32, 16, 10, 3 nodes of each level for achieving the beauty effect learning.

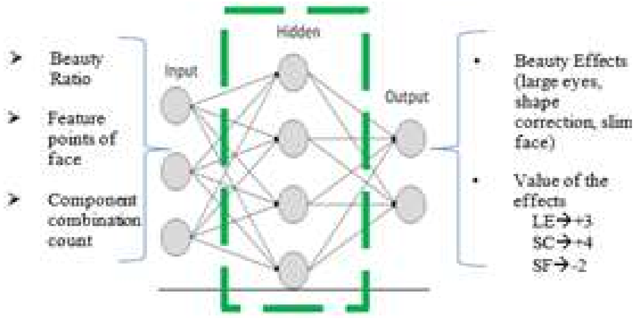
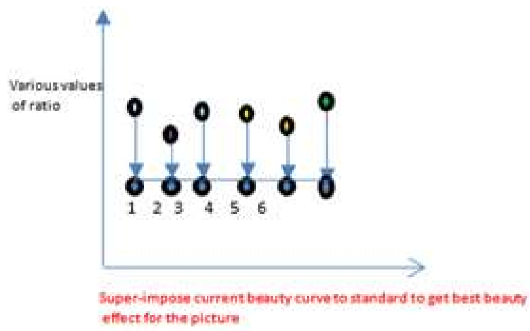


Fig. 6. It shows what input the neural network layer takes and the output generated by the hidden layers are prediction of the beauty effects and its value as a whole number

Normalizing the data generally speed up the learning and leads to faster convergence. If a feature is all positive or all negative, this will make learning harder for the nodes in the layer. There will be a zigzag graph like following a sigmoid activation function. So if you transform it near to the zero, it gets easier to plot as well as there are both positive and negative numbers.



In our algorithm, we used the normalization to find the value to beauty effects calculator, which here is termed as 'K'. Here the normalizing factor used is 100 which remains constant.

$$K = \frac{Number\ of\ beauty\ ratio\ *(sum\ of\ differences\ in\ ratio's)}{Normalization\ factor}$$

where no. of beauty ratio are mapped to the standard curve, sum of difference ratios of the curved shift,

Normalization factor = 100.

By the use of normalizing factor the distortion of the face gets decreased and the face looks enhanced. As the standard beauty ratio values are also used to calculate the factor, it enhances the face with less distortion in it.

Super Impose: The mapping function will provide the value of k after processing from the neural network. As we just passed the beauty ratio value, the neural network has to decide what to do with the beauty ratio whether to: superimpose completely or average and predict the number K by liner progression for the effect. If all ratios are not beauty ratio values based on mapping function. This is the first try by the neural network, if not satisfied then run the algorithm to find the least value of K which satisfy the equation.

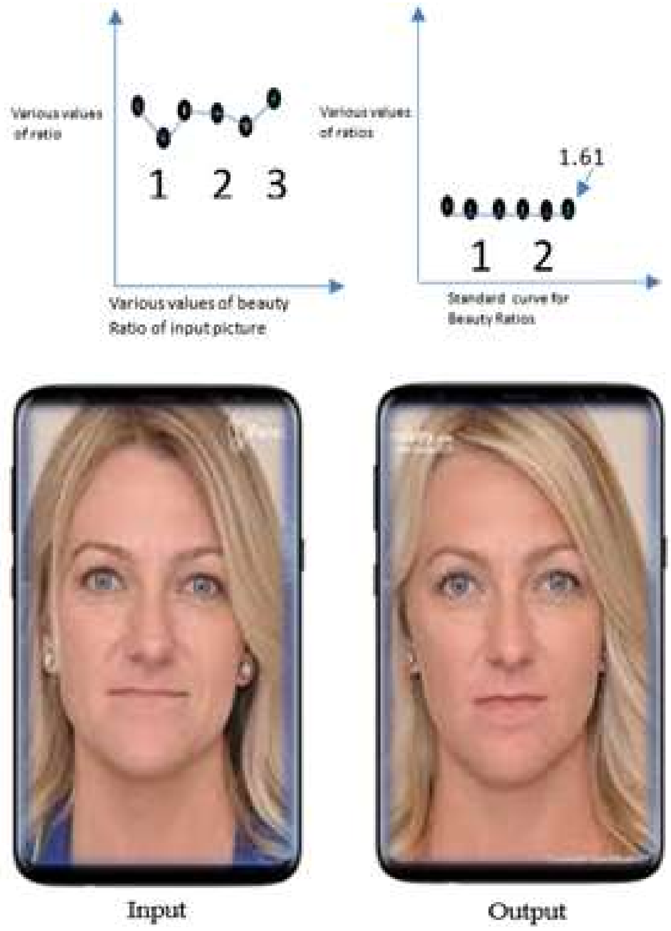


Fig. 7. The graphs shows how the superimposition of the ratios is done and the above images shows that how the output differs from the input

If less than (number of beauty ratio)/2 is not matched from the standard curve, then map ratios to average distance, because the weights of beauty ratio mapped are high. This is the first try to impose to half, if not satisfied then NN will calculate the value. If only a few ratios don't lie to the standard curve and if we shift the curve completely then there may be a chance of overlap then there may be a situation that the face can be distorted

RESULTS

Its Accuracy is 95%, which will improve further after taking user responses approx. to 98%. Earlier without using ML, the maximum accuracy obtained was 75%. It did not improve further as all the ratios are fixed and the machine/mobile app did not take any feedback to learn from the original data given by the user.

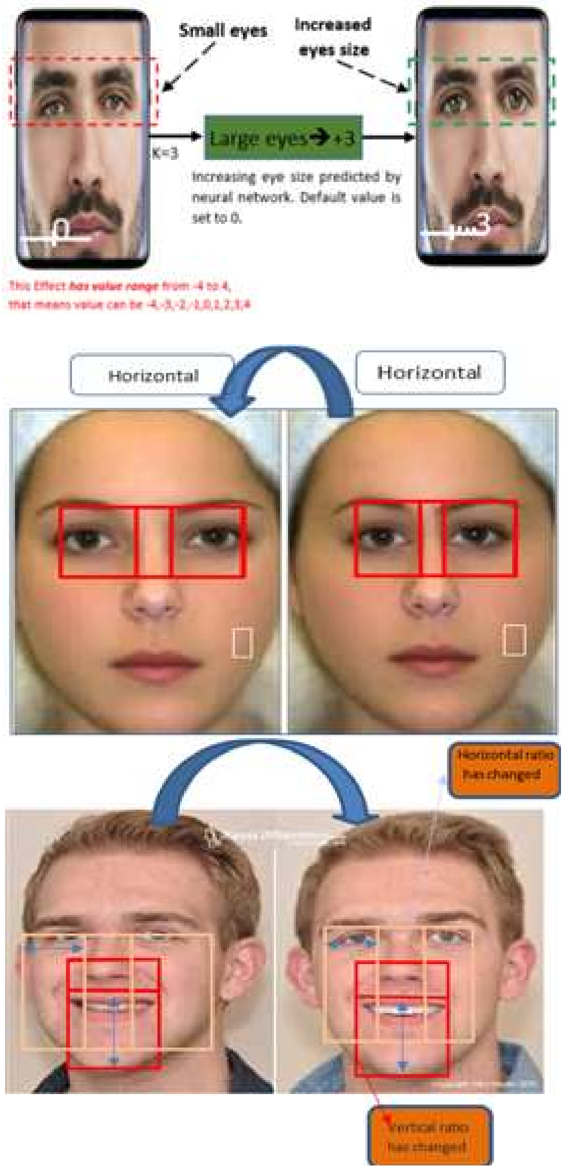


Fig. 8. Various horizontal and vertical ratios have been calculated and used to improve and enhance the structure of the face of the user. Here the prominent feature of the face, i.e., eye is taken as an example to show how the enlargement of the eye is done which enhances the structure of the face.

We use unsupervised learning for better results, the value of 'k' is also not fixed, and it depends on user input, which is very helpful in getting better results. Our results include correcting all parts of the face by doing structural changes on the face by applying appropriate beauty ratios.

Usually, there are four types of Structural changes in the face:-

- Nose Reshape
- Forehead
- Jaws
- Thin Nose

These Structural changes depend on the beauty ratio, which is calculated by our model to give the best result each time. The invention reduces user manual effort for applying the beauty effects as lots of combinations are there for given settings and it is a tedious job to get what will be suitable to the user's face. Unsupervised learning time is very that's why we consider it for the first phase. Unsupervised learning is used for the first phase of the detection of beauty effects with 80% accuracy,our beauty score is determined by examining various points on a person's face and then normalizing the results. In fig., the beauty score of the output images captured by various market phone devices, such as Samsung, Vivo, and Oppo, and output by our method was calculated.

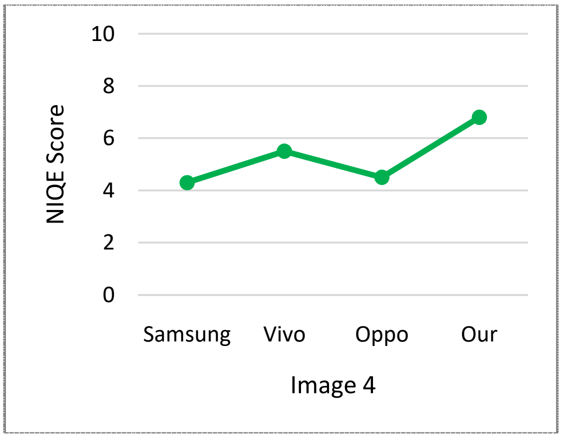


Fig. 9. Beauty score comparison for different devices

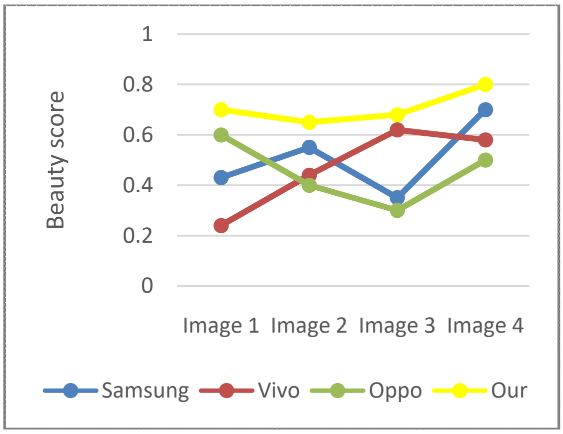


Fig. 10. NIQE score comparison for different devices

Fig. 11. Output results

Conclusion

In this paper, we have proposed an approach to provide incredible precision, accuracy, and faster AI-generated image of the face of the user which enhances the photography experience. Previously only the brightness and smoothness of the image has to be aimed, but our main focus is to reduce the abnormalities in the face structure. Also, manual editing gets minimized as everything is automated through the deep learning network. Our algorithm utilizes lots of combinations of beauty ratios and provides the best effect to the particular face which suits it a lot.

References

1. Evaluation of the Putative Ratio Rules for Facial Beauty, IEEE explore paper ,2014
2. Kinship Measurement on Salient Facial Features , IEEE explore paper ,2012
3. Occlusion Aware Facial Expression Recognition Using CNN With Attention Mechanism , IEEE explore paper ,2019
4. Web-based database for facial expression analysis ieee explore paper, 2005 [5] Vertical and horizontal facial proportions of Indian American men , Synapse 2016
5. A Comparison of Face and Facial Feature Detectors Based on the Viola-Jones General Object Detection Framework , accedacris ,2011
6. A Novel Approach for 3D Head Segmentation and Facial Feature Points Extraction , IEEE explore paper
7. Facial Feature Point Detection , International Journal of Computer Vision 2014
8. The Face of Fear and Anger: Facial Width-to-Height Ratio Biases Recognition of Angry and Fearful Expressions , American psychological association , 2017
9. New "golden" ratios for facial beauty , Science direct 2010
10. Eye–Mouth–Eye Angle as a Good Indicator of Face Masculinization, Asymmetry, and Attractiveness American psychological association , 2017
11. Evaluation of Facial Beauty Using Anthropometric Proportions ,the scientific world journal , 2014
12. Analysis of the soft tissue facial profile by means of angular measurements European Journal of Orthodontics, Volume 30, Issue 2 , 2008
13. Multiracial Facial Golden Ratio and Evaluation of Facial Appearance 2015
14. Occlusion aware facial expression recognition using CNN with attention mechanism, 2018
15. Geometric Facial Components Feature Extraction for Facial Expression Recognition, 2018
16. Automatic detection of individual and touching moths from trap images by combining contour-based and region based segmentation, 2017
17. Automatic skin lesion segmentation on dermoscopic images by the means of superpixel merging, 2018
18. Image reassembly combining deep learning and shortest path problem, 2018

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