Machine Learning Approach for Hairstyle Recommendation

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Abstract—**According to aesthetic evaluations, hair is the most unique feature which can enhance the facial features of a person. Beauty experts have identified that 70% of overall face appearance completely depends on the haircut or hairstyle. The physical attributes such as the haircut is a major determinant of women's psychology. This is the essence of why a haircut which is matching a woman's face is necessary articulation. But selecting the right haircut or hairstyle is one of the most difficult decisions to take in a woman's life. This paper presents a novel framework to select the most suitable hairstyle or haircut by classifying the face shape. The author considers the shape of the face, beauty experts knowledge related to hair cuts and hairstyles and the length of the hair to develop a model to recommend the most suitable hairstyle or haircut. The author focused to recommend the haircuts and hairstyles for women which is a subsection of this large research area. According to beauty experts identifying the shape of the face is the most important step before selecting the right hairstyle or haircut. The proposed model has the ability to classify the face shape when a user uploaded a portrait of herself. Machine Learning libraries were used to identify the landmarks of the face image and classify the face in the correct shape. Naïve Bayes classification algorithm has used to recommend the most suitable hairstyle or haircut according to the detected face shape, hair length and information collected from the hair experts. User has given an option to share the recommended hair style or haircut with the beautician via "The Beauty Quest" Salon network platform. Five thousand images were trained, and python language has used as the programming language. The accuracy of the face shape classification model is 91% and the accuracy of the hair recommendation is also 83%.**

Keywords—computer vison, hairstyle recommendation, machine learning, face shape classification

I. INTRODUCTION

Hair is one of the most individual unique expressive features of a person. Beautiful hair always adds an extra effect to physical appearance. Because of that it is very important to have a good haircut or a good hairstyle. A good haircut or a hair style can remove the neglected appeal of the hair. A good haircut can highlight facial features and it has the ability to improve appearance of the face by 70% [1]. A good haircut is a key to instantly gratifying transformation. Psychologists say that appearance and the feeling of a beautiful hair directly impacts to the women's psychology. This is the essence why a haircut which is matching a woman's face is a necessary articulation. For example, for a woman with an oval face shape will have a large forehead. This can be reduced by selecting the correct haircut. To be a good haircut, the haircut should definitely suit to the facial features of a person. According to the knowledge of the beautician, facial features vary according to the face shape. There are five major face shapes have been identified such as oval, oblong, round, square and heart. A haircut or hairstyle totally depends on the face shape and hair length of a person. Haircut selection process needs to be done by a skilled and knowledgeable expert in the beauty culture industry. One cannot select a haircut just by going through magazines or other books since everyone is unique in their appearance. The expert consultation takes a considerable monetary amount and therefore this application provides a free service which the user cannot obtain using any other source. This research paper presents a novel approach to recommend hair styles to women using face shape classification. The proposed model considers the face shape, hair length and expert knowledge to recommend the most suitable haircuts and hair styles to users. The proposed hair style/haircut recommendation system require a portrait image from the user, process the image and automatically recommends the most suitable haircut or up do hairstyle to the user. When you cut the hair, it cannot be undone because of that selecting the most suitable hair cut is very important. Because of that system provides an option to the user to share the recommended hair style with a beautician via the "The Beauty Quest" salon network application. The data set for the face shape classification obtained from the Kaggle and the 5000 images were trained. Haar Cascade Classifier in the open CV used to identify the face region. dblib library is used to identify the face landmarks and the thresholding techniques used to separate the hair and the forehead. Naive bayes Classification has used to recommend suitable hairstyle/haircut to the users according to face shapes and hair lengths. The aim of this research is to automate "haircut and hairstyle recommendation using cutting edge-technologies for day -to-day benefit of mankind.

II. LITERATUE REVIEW

A. Physical beauty vs Pshcylogy

Socio behavioral researches have given the idea that the hair cut can influence the physical attractiveness of a person. This can indirectly influence on the personality of that person. It will ultimately have an impact on the personal life [2]. It has been also found that physically attractive people tend to grab the attention of the others in terms of warmth, kindness, sensitivity and poise. They will eventually possess social, material and occupational success. Dr. Ellen Berscheid projects the idea that the physically attractive people who prefer various treatment methods to enhance their beauty, could have a lasting impression on that person's lifestyle. She also states that the beauty parlor industry will be a growing projections since the physical attractiveness is depicted as an important factor in day-today life [3]. The first expression counts in mostly romantic scenarios and therefore the physical attractiveness will play a major role.

The hair cut will have a strong impact on the physical attraction of a person. The behavioral scientists has found out that the physical attractiveness will be a key factor in determining the psychological behavior of a person. According to researches 70% of the face appearance depends on the hair attribute of a person and because of that it is very important to maintain the hair [1]. It is observed that physical attractiveness has important social consequences directly affects to the psychology. Thus author decided to develop a system to give personalized recommendations on haircuts.

B. Face Region Identification

Various Approaches have been identified to detect the face object in machine learning and image processing subject areas. Mainly, face detection can be categorized in to four approaches such as appearance based, knowledge based, feature based and template matching methods [4].
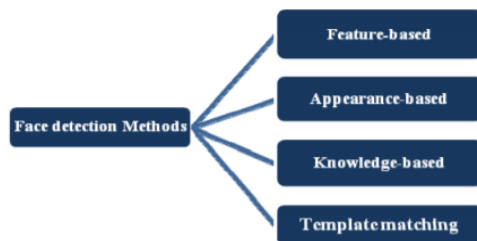

Figure 1 Face detection approaches

Source [5].

1) Feature based approach: The features in human face are very unique and it is easy to identify specifically.This technique is about the mining features which does not have any changes of illumination and occulsion of an image.In this approach feature restoraion is a challenge but this method has some advantages like, scale independancy,rotation independency [6].

2) Appearnce based approach: Apperance based approach is considerd as a 2 class pattern recognition issue.Adaptive boost classifier comes under this appearnce based technique .

3) Knowledge based approach: In knowledge based approach simple rules are defined.The challenge is translating human knowledge in to rules which can be used in face recognition [6].

C. Convolutional Neural Networks in face recognition

In the field of computer vision deep learning algorithms such as Convolutional Neural Network (CNN) plays a major role. Convolutional Neural Networks (CNN) can extract features by ignoring inference layer [7]. More effort should be given to fine tune the pre trained model but model performance that used CNN has observed to be poor CNN require quality and large data set to give better results. Commonly, Neural Networks can improve the performance based on the quality of the data set but the execution time is very high. Convolutional Neural network approach will be only applicable to a large data set. Therefore, author did not adapt the CNN algorithm.
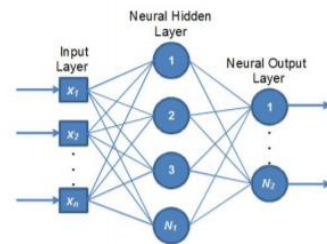

Figure 2 Architecture of neural networks

Source [8].

III. METHODOLOGY

In order to develop the automatic hairstyle recommendation system;

1) First Foremost,need to classify face images in to face shape.

2) Next,Set of appropriate hairstyles should be defined and recommended according to the face shape and the hair length of a person.
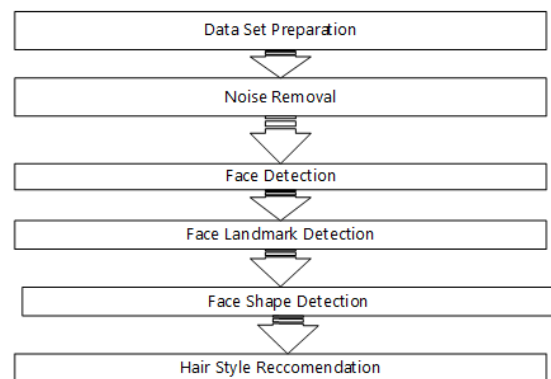

Figure 3 Overview of the Methodology

A. Data Collection

Data Set for the face shape classification obtained from Kaggle [9]. The dataset consist of 5000 images of different

face shapes. Data set divided as 70% and 30% respectively to training and testing.

B. Face Detection

Human face detection has been a trending and challenging issue in the areas of pattern recognition and image processing. Because of different occlusions, illuminations, backgrounds and other uncertainties. Most of the time face detection remains a challenging issue in real-world applications. When a user input a portrait image first foremost system should identify the face region. For face detection author has used a machine learning-based approach.HaarCascade classifier in the OpenCV is used to identify the face region. A cascade can be used to identify lines, circles, and edges with different colour intensities. A cascade created combining different wavelets. Several features combined to detect the face because a single classifier does not give accurate results. Haar feature has the ability to detect even a small feature of an image Chosen scale is smaller than the target image and scale is positioned on the image, an average of the values of pixels in each is taken.1.25 scale is given to the cascade and reiterated to find different sized faces. The presence of Haar Like feature is identified by subtracting the average dark region pixel value from the average light region pixel value. Presence of the feature can be identified by calculating the threshold. Haar-based classifier output returns a square bounding box as a two dimensional array. OpenCV Haar-based classifier is significantly faster technique to detect the face object. The division of the data set distributes as testing and training data, 30% and 70% respectively. By the use of OpenCV, test results on images of people, under several levels, illuminations and occlusions in both training set and test set depict that the proposed algorithm is effective and achieves the desired performance.

C. Face Landmark Detection

After detecting the face region, it is very important to detect the landmarks of the face in order to classify the face shape. Facial landmark detection is a subset of face shape classification process. Facial landmarks are used to represent salient features of the face such as eyes, eyebrows, nose, jawlines, mouth. The pretrained facial landmark detector inside the dblib library is used to estimate the location of 68(x, y)coordinates which maps the facial structure of the face .
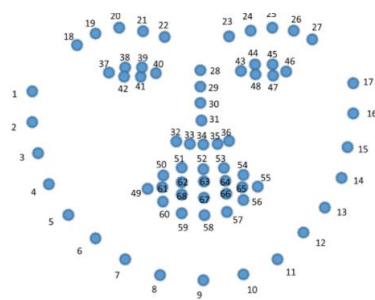

Figure 4 Face landmarks

After recognizing the face region dlib face landmark detector return a shape object containing the 68 (x,y) coordinates of the face landmark region.Rather than 68 points in the face hairline which separate the hair and forehead must be identified.Dlib machine learning library does not support the identification hair line.Therefore author has use

thresholding techniques to separate the hair and forehead.In order to use the thresholding techniques images with RGB color channels should convert to gray scale images by using gray scaling method in OpenCV. Then, binary inverse thresholding method applied to the gray scale image.The most difficult task was to identify the threshold value as different documents consist of different colors.Adaptive thresholding otsu method has used to overcome this problem.Otsu's method in adaptive thresholding determine optimal threshold value. By applying this value noise of the image can be removed.

D. HairCut/ Hair Style Recommendation

Choosing the most suitable haircut for a women is very difficult.In order to overcome this problem author develop an approach to recommend the most suitable hair style or hair cut automatically.Because computer based recommendation is very easy and accurate.

A good data set is the key to high performance. To create the hairs style recommendation data set a survey was done using a website and it was distributed to the general public. guidelines were provided by obtaining the expert ideas of the beauticians. Portrait images were inserted to thewebsite. And the participants were informed that their face shape was been recorded. Hair length was taken as an input. In order to find out the preferences of the customers, haircuts and hairstyles were shown according to their face shape and hair lengh.The respondent was given the chance to vote their likes or dislikes to the haircuts and hairstyles which were suggested in a given probability scale.

Figure 5 Hair recommendation data set

Data preprocessing was carried out to reduce the anormalizies.Nominal data were converted to binary which includes 1 and 0.The data set is trained with leave-one out method and Naïve Bayes callisfication algorithm is used to give the recommendation.Missing values of data set were filled using mean of overall rating.As nominal variables converted to binary maximum and mimum rating Rmin and Rmax taken to select threshold value t as (Rmin + Rmax)/2.Next Converted the ratings greater than t as 1 and less than t as 0 In 1-5 rating scale converted 1,2,3 in to 0 and 4,5 in to 1.Using probability values hair recommendation done using Naïve Bayes

IV. RESULTS

The system results were evaluated with the help of Evuni academy of beauty.With the help of Evuni academy of beauty prototype of the system given to Evuni salon network which includes 5 salons,.Totally 200 participants have been participated for the system testing and evaluation.

Accuracy of the face shape identification module was 91%.

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accuracy                              0.89        80
macro avg            0.91    0.89     0.89        80
weighted avg         0.91    0.89     0.89        80
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Figure 6 Classification Report of Face Shape identification

Accuracy of hair cut/hair style recommendation module was messured in collbaraion with hair dresssers and partcipants.Recommended hair style /hair cut for the users shared with the beauticians and they evaluated the hair cut /hair style suggestion with their expert knowledge. Accuracy of the hair recommendation module is 83%.

Figure 5 Accuracy /validation curve observed

Overall system evaluation carried out considering three basic criterias.
1) User Intercation Assesment
2) Face Shape classification Assessment
3) Haircut Reccomendation Assesment

Overall performance Assessment carried out under these sections.User interaction assessment and system evaluation carried out considering user experience ,user interfaces and user interaction,accuracy of the algorithms and their results. The Overall Evaluation of the product was carried to verify whether the system's final outcome meets the functional requirements of the users and the functional requirements of the users and the successfulness of the system tasks and the functions of each component are also evaluated here. The accuracy/validation graph of the trained data is plotted and was found to be very impressive.

V." CONCLUSION

The objective of this research was achieved by developing a haircut/hairstyle recommendation system by considering the face shape classification and the length of the hair. Most of the time customers does not be happy with the hair cut when they attend to a salon. This proposed model also addresses the issue of customer dissatisfaction. Author used Machine Learning libraries to identify the face region of the portrait image and according to detected landmarks the system classifies the face into the correct face shape. Naïve Bayes classification algorithm has used to recommend the most suitable hairstyle considering the detected face shape, length of the hair and information collected from the beauty experts. The system has given an option to the user to share the recommended hair style or haircut with the beautician via "The Beauty Quest" Salon network platform. Five thousand images were trained, and python language has used as the programming language. The accuracy of the face shape classification model is 91% and the accuracy of the hair recommendation is also 83%. Furthermore, Authors look forward into optimizing software developed to predict results with high quality.

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