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Human Skin Detection Using Different Color Spaces

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Abstract – *Human skin color is an important factor to infer variety of aspects including beauty, race, culture and age etc. Detection of human skin color plays more importance in numerous applications such as face recognition, skin disease detection, gesture tracking and human-computer interaction. The detection of skin and non-skin color pixels and its classification is a challenging task. In an image the skin color is sensitive to various factors such as camera characteristics, ethnicity, shadows, illumination, motion background colors, also influence skin color appearance A reliable human skin detection method is the one which is adaptable to different human skin colors and illumination effects for better human skin segmentation. Although various human skin color detection solutions have been effectively applied, they prostrate with false skin detection and are not able to cope with the variety of human skin colors across different ethnicity. Also, existing methods need high computational cost. This work aims at providing a technique which produces more robust and accurate results with minimum computational cost. The suggested technique combines HSV color space and YCbCr color space for human skin detection in color images. This technique reduces computational costs as no training is required and it also improves the accuracy of skin detection despite wide variation in illumination, ethnicity and background.*

Key Words*: HSV, Image Processing, OpenCV, RGB, Skin Detection, YCbCr.*

1. INTRODUCTION

The process of finding skin-colored pixels and regions in an image or a video is called skin detection. This process is used as a preprocessing step to find regions which potentially have human faces and limbs in images. Skin image recognition is used in a wide range of image processing applications like face recognition, skin disease detection, gesture tracking and human-computer interaction.

The skin color is the primary key for skin recognition in an image. But color cannot be the only deciding factor due to the variation in skin tone according to different races. Other factors such as the light conditions also affect the results. The skin tone is often combined with other cues like edge and texture features. This is achieved by breaking down the image into individual pixels and classifying them into skin colored and non-skin colored.

A simple method is to check if each and every skin pixel falls into a defined color range or values in some coordinate ranges of a color space. There are many skin color spaces like YIQ, YUV, RGB, HSV, YCbCr, etc. that are used for skin color segmentation. We have proposed a new threshold range based on the combination of RGB, HSV and YCbCr values.

The following factors should be considered for determining the threshold range:

1) Effect of illumination depending on the surroundings.
2) Individual characteristics such as age, sex and body parts.
3) Skin tone varying with respect to different races.
4) Other factors such as background colors, motion blur and shadows.

The skin detection is also influenced by the various parameters like Brightness, Contrast, Transparency, Illumination, and Saturation. The detection is normally optimized by taking into consideration combinations of the mentioned parameters in their ideal ranges.

2. LITERATURE SURVEY

According to Gururaj P Surampalli, Dayanand J, Dhananjay M [1]. Skin detection plays very important and crucial part in many biometric systems. The work has been administered to know and analyze the log opponent, HSV, YIQ and YCbCr skin pixel detection techniques. Each technique performs the pixel detection using different set of parameters for detecting skin pixel and non-skin pixel. The proper analysis is carried out during the present work, which involve applying each technique to set of images present in database. The comparison of each technique for the single image is performed. Further this work extends for comparing with log opponent, HSV, YIQ, and YCbCr for skin pixel detection ability. Results show that log opponent, YIQ fails to detect the right skin pixel. Hence analysis is emphasized on HSV, YCbCr. During the comparison of HSV, YCbCr it is found that skin pixel detection efficiency of HSV is 3.57% and for YCbCr is 96.42% for the set of images used from database.

According to Hani K. Al-Mohair, Junita Mohamad-Saleh and Shahrel Azmin Suandi [2]. Skin detection is an important process in many of computer vision systems. Color space information is assumed to possess an impression on increasing the separability between skin and non-skin pixels. In this paper, we compared between 5 color spaces for skin detection using the MLP neural network. Then, some statistical texture features were wont to enhance the accuracy of detection. When color information is used alone, the experimental results showed that the YIQ color space gives the highest separability between skin and non-skin pixels measured by accuracy AC and F1-measure. However, the general results emphasize that pixels color information alone can't be wont to achieve accurate skin detection. Combining color and texture may cause far more accurate and efficient skin detection.

According to S. Kolkur, D. Kalbande, P. Shimpi, C. Bapat, and J. Jatakia [3]. This paper demonstrates a threshold-based algorithm which enables to recognize skin image using the RGB-HSV-YCbCr model. The algorithm is capable of processing images of various light conditions like brightness etc. Our algorithm gives promising results in terms of precision and accuracy when compared with baseline dataset as seen. The future scope of this algorithm is to detect face, hand as well as hand gestures which can be used for security purpose, aid for physically challenged individuals or for skin disease detection.

According to Leyuan Liu, Rui Huang, Saiyong Yang and Nong Sang [4]. In this paper, a way for detecting skin colors under varying illumination is proposed. First, spatial illumination variation is identified, and the images are segmented into different regions with different illumination. Each illumination region of color images are corrected base on the illuminant estimated by an area edge-based colour constancy algorithm. Then, the corrected images are transformed into a color-space, where statistical results on a large-scale skin dataset show that the skin color cluster and non-skin color clusters are separated. Finally, the skin colors are being modeled under Bayesian decision framework and are classified from non-skin colors. The experimental results show that the proposed method is robust to illumination variations.

According to Bishesh Khanal and Désiré Sidibé [5]. In this paper an efficient and robust skin detection method is proposed. This method is totally based on finding human skin locus in the log-chromaticity color space. Based on invariant properties of this color space, a skin detection method is developed and extensive experiments with a large dataset show that the proposed method is robust against shadows and severe illumination changes for images under natural sunlight. Comparison with many other approaches show that the proposed method achieves the best tradeoff between correct classification of skin pixels and false detection of nonskin pixels. The simplicity and the robustness of the method make it suitable for real-world robotic applications. Our future work includes using the proposed method for person detection and live tracking with a mobile robot.

According to Leyuan Liu, Nong Sang, Saiyong Yang and Rui Huang [6]. In this paper, we've presented a real-time complexion detection method which mixes dynamic adaptation and color correction strategies to handle rapidly changing illumination conditions. Face detection is employed to online sample skin colors and a dynamic thresholding technique is used to update the skin color model under Bayesian decision framework. Color correction strategy is employed to convert the colors of the observed frame when there is no face detected, so that the skin color model is still effective on the color corrected image. A simple but effective method is also proposed to detect illumination changes, and the skin color model is updated only if the illumination has changed. Benefiting from this model update scheme, the proposed skin color detection method can run in real-time on general consumer hardware. The proposed complexion detection method has tested under real human-computer interaction application environment, and a 2.98% false positive rate and 10.96% false positive rate were achieved. In our experiments, some non-skin colors were misclassified as skin colors by the proposed method when “false” faces (such because the face printed on clothes) were detected. Future research remains required to get rid of these “false” faces when sampling skin pixels for building and updating the complexion model.

3. EXISTING SYSTEM

According Detection of human skin is most importance in numerous applications including gesture analysis, recognizing human by human and/or machine and face tracking. The detection of skin and non-skin color pixels and its classification is a challenging task. In an image the skin color is sensitive to various factors such as camera characteristics, ethnicity, hairstyle, makeup, shadows, illumination, motion background colors, also influence skin color appearance. A reliable human skin detection method is the one which is adaptable to different human skin colors and illumination effects for better human skin segmentation. Although various human skin color detection solutions have been effectively applied, they prostrate with false skin detection and are not able to cope with the variety of human skin colors across different ethnic. Also, existing methods need high computational cost. Also, there are many human skin detection methods in the current trend, which uses different color spaces along with various algorithms on the images to overcome all the illuminations for detection of human skin. Such existing methods result in less accuracy, need high computational cost, and more execution time.

Disadvantages:

- The existing methods prostrate with false skin detection and are not able to cope with the variety of human skin colors across different ethnic.
- Various factors such as camera characteristics, ethnicity, hairstyle, makeup, shadows, illumination, and motion background colors are not considered.

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- The existing skin detection methods require high computational cost and more execution time.

4. PROPOSED SYSTEM

The system aims at providing a method which provides more robust and accurate results with minimum computational cost irrespective of various factors such as camera characteristics, ethnicity, hairstyle, makeup, shadows, illumination, motion background colors, also influence skin color appearance. The suggested method combines HSV color space model image and YCbCr color space model image for automatic human skin detection in color images. This method reduces computational costs as no training is required and it also displays the output with higher accuracy of skin detection despite wide variation in illumination, ethnicity and Background. This system also overcomes the effect of illumination depending on the surroundings, individual characteristics varying skin tone with respect to different regions and other factors such as background colors, shadows etc.

Advantages:

- The system provides robust and accurate results.
- Implementation and deployment of this system requires minimum computational cost and minimum executional time.
- Different color space models are used for skin detection. OpenCV consists of methods to apply HSV & YCbCr color space models on the image.

5. METHODOLOGY

Back-End Design:

With the help of Python packages and use of Spyder IDE we proceed with our design to implement the project:

1. Setting Spyder environment and importing packages OpenCV, numpy & webbrowser for running our code. For importing images, test images must be stored in the specified address in .jpeg, .png extensions.
2. Test image is converted into RGB image model as the first phase of the model. RGB image model will be basic model for testing other model on the test image for calculating accuracy.
3. RGB model will be tested for two different model namely- 1) HSV(Hue-Saturation-Value) & 2) YCbCr (Luminance and Chrominance)
4. In second phase of testing RGB model will be converted to the HSV model (Binary Image) and accuracy of determining the skin from the test image is calculated
5. Similarly, RGB model will be converted to the YCbCr model (Binary Image) and accuracy of determining the skin from the test image calculated.
6. Results of both the HSV model and YCbCr model can be improvised by combining both the model results which accounts for giving highest accuracy than both the models individually.
7. When there is no face detected on the image, it will return a blank image (black). Therefore, for testing purposes we can use to detect human skin in the image
8. Resulting output will be displayed individually on a web page.
9. In order to make the system model to test on multiple images, the model is integrated with flask and flask-cors python packages in the frontend.
10. "Try with Another Image" button helps to run on different test images without opening the IDE again and again.

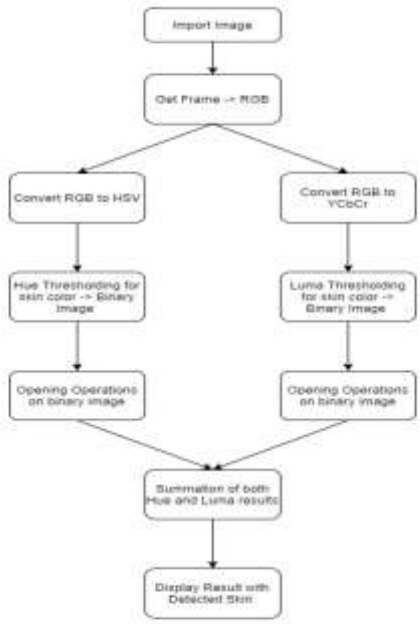

Fig -1: Flow diagram of proposed system

Front-End Design:

By applying the HSV and YCbCr color models in the python environment the results will be displayed in a webpage on the web browser. The expected individual outputs, include RGB (Original Image), HSV color space output, YCbCr color space output and the final global image which is the summation of both HSV & YCbCr color space model image outputs. The webpage also provides a button to test the system model on different images.

6. RESULTS

Fig -2: Window to upload image.

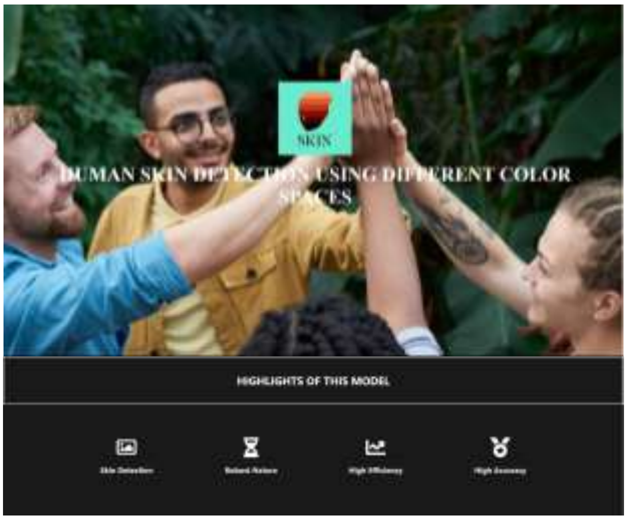

Fig -3: Webpage

Fig -4: Original image with elevate zoom.

Fig -5: HSV color model image with elevate zoom

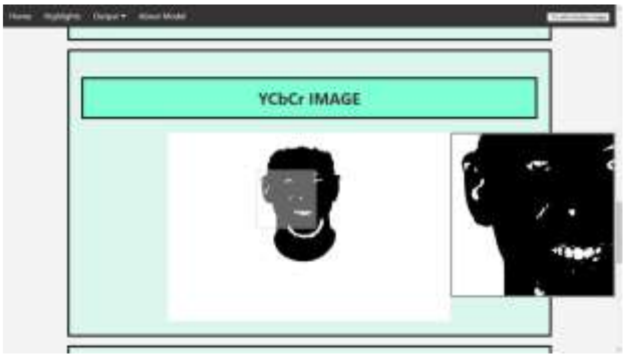

Fig -6: YCbCr color model image with elevate zoom

Fig -7: Global image model image with elevate zoom

Fig -8: Try with another image by clicking the button

7. FUTURE SCOPE

The development of these methods and models are really vast. Further, the skin detection model can be developed in a way to identify a particular color out of a colored photo. The enhancement of this system can be done by applying different algorithms and methodologies such as Fuzzy Entropy, Fusion Methodologies, Artificial Neural Networks and Convolutional Neural Networks. This model also can be deployed in many ways such as face detection, adult content filtering, live skin detection and human interactions with systems etc. for better performing models. The Models can be developed in different ways by using some latest packages like OpenGL, TensorFlow and Caffe that will help us to give alternative procedures which will identify skin and perform functions as per the requirement.

8. CONCLUSION

This model concludes by using the topics of computer vision like OpenCV, it can help in converting an image from one color space model to another, merge different color space models, mask the image in specified range, edit, modify and save images. This model can identify human skin by using color space models which is spontaneous and robust in nature. Further this model can be enhanced using different algorithms and methodologies too. This can provide ease use of systems and many other applications. So, the open CV is helping the users with different accessible forms of models that will make ease life.

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