A Fusion Approach for Human Skin Detection Using Canny Edge Algorithm

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Abstract--- **A reliable human skin detection method that isadaptable to different human skin colors and illumination conditions is essential for better human skin segmentation. Even though different human skin-color detection solutions have been successfully applied, they are prone to false skin detection and are not able to cope with the variety of human skin colors across different ethnic. Moreover, existing methods require high computational cost. In this paper, we propose a novel human skin detection approach that combines a smoothed 2-D histogram and Gaussian model for automatic human skin detection in color images on Sobel edge operator.**

In our approach, an eye detector is used to refine the skin model for a specific person. The proposed approach reduces computational costs as no training is required and it improves the accuracy of skin detection despite wide variation in ethnicity and illumination. Sobel edge can be sensitive to noise and inaccurate. Using canny edge detector better detection can be occurred specially in noise condition and also improving signal to noise ratio. Canny edge is essential for better human skin detection.

Keywords: **Color space, dynamic threshold, fusion strategy,skin detection.**

I.INTRODUCTION

Designing a system for automatic image content recognition is a non-trivial task that has been studied for a variety of applications. Computer recognition of specific objects in digital images has been put to use in manufacturing industries, intelligence and surveillance, and image database cataloging to name a few. In this project, a prototype algorithm for automating the detection of human skin in digital photographs was developed and can serve as an introduction for future work in detecting people in images.

With the progress of information society today, images have become more and more important. Among them, skin detection plays an important role in a wide range of image processing applications from face tracking, gesture analysis, content-based image retrieval systems to various human–computer interaction domains. In these applications, the search space for objects of interests, such as hands, can be reduced through the detection of skin regions. One of the simplest and commonly used human skin detection methods is to define a fixed decision boundary for different color space components. Single or multiple ranges of threshold values for each color space components are defined and the image pixel values that fall within these predefined ranges are selected as skin pixels. In this approach, for any given color space, skin color occupies a part of such a space, which might be a compact or large region in the space. Other approaches are multilayer perceptron Bayesian classifiers, and random forest, these aforementioned solutions that use single features, although, successfully applied to human skin detection.

II.SKIN DETECTION

A novel approach, fusion framework, that uses product rules on two features; the smoothed 2-D histogram and Gaussian model to perform automatic skin detection. First of all, we employ an online dynamic approach as in to calculate the skin threshold values. Therefore, our proposed method does not require any training stage beforehand. Second, a 2-D histogram with smoothed densities and a Gaussian model are used to model the skin and non skin distributions, respectively. Finally, a fusion strategy framework using the product of two features is employed to perform automatic skin detection. To the best of our knowledge, this is the first attempt that

Fig.1. Flow of skin detection

The image pixels representation in a suitable color space is the primary step in skin segmentation in color images. A better survey of different color spaces (e.g., RGB, YCbCr, HSV, CIE Lab, CIE Luv, and normalized RGB) for skin-color representation and skin-pixel segmentation .In our approach, we do not employ the luminance-invariant space. Indeed, we choose the log opponent chromaticity (LO) space.

The reasons are twofold: first, color opponency is perceptually relevant as it has been proven that the human visual system uses an opponent color encoding and second, in this LO color space, the use of logarithms renders illumination change to a simple translation of coordinates. Most of the aforementioned solutions claimed that illumination variation is one of the contributing factors that degrade the performance of skin detection systems. However, our empiricalshowed that the absents of luminance component do not affect the system performance.

A skin classifier defines a decision boundary of the skin-color class in the color space based on a training database of skin-color pixels. For example, is used fixed range values on the HS color space where the pixel values belong to skin pixels in the range of and. Wang and Yuan used threshold values in space and HSV space where threshold values are set to be within the range, and to differentiate skin and non skin pixels.

In these approaches, high false skin detection is a common problem when there are a wide variety of skin colors across different ethnicity, complex backgrounds, and high illumination.

A.FrameworkFor Automatic Skin Detection

In Proposed framework eye detector, 2-D histogram, Gaussian model, and fusion strategy. the proposed framework for automatic skin detection. First, an approach similar to that of Fusel is adopted to obtain the faces in a given image. Second, a dynamic method is employed to calculate theskin threshold values on the detected faces region.

Third, two features—the 2-D histogram with smoothed densities and Gaussian model—are

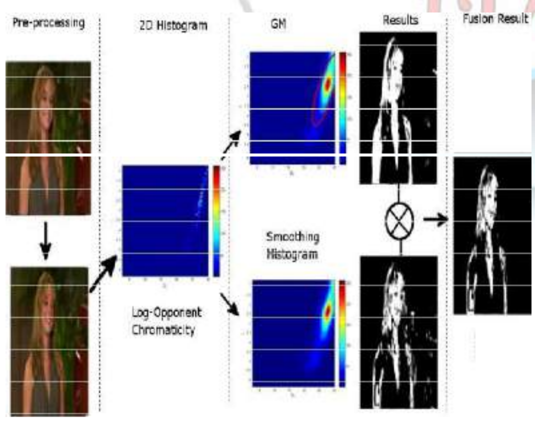

Fig.2.Automatic skin detection

introduced to represent the skin andnon skin distributions, respectively. Finally, a fusion frame work that uses the product rule on the two features is employed toobtain better skin detection results.

B.Preprocessing Method for using Skin Detection

In the preprocessing steps, for any given images, where is the number of images, _where is the number of images, .we first first _∈ {1,2, ... , } illustrated in Fig. 3 is used_(_ to,_generate the elliptical face region in the images. Here, _ _) is the center of the ellipse as well as the eyes symmetry point. Minor and major axes of the ellipse are represented by 1.6D and 1.8D respectively, where D is the distance between two eyes. For a more detailed description, interested readers are encouraged to read.

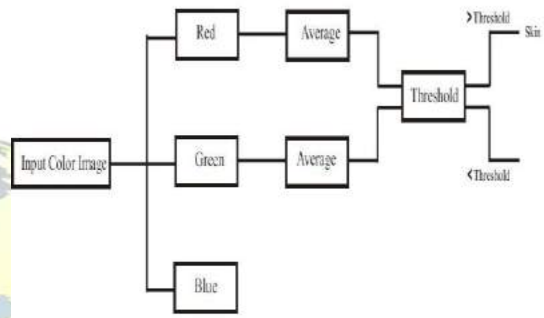

Fig.3. Pre Processing

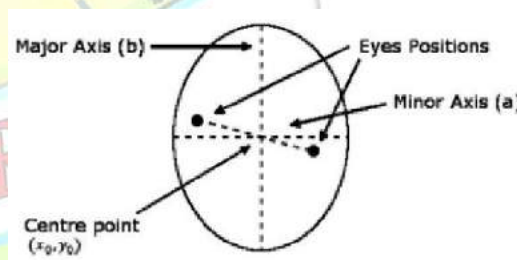

Fig. 4. Elliptical mask model generated using eye coordinates.

The detected face regions include smooth (i.e., skin) and nonsmooth (i.e., eyes, eye brown, mouth, etc.) textures. As we are only interested in smooth regions, Sobel edge detection is employed to remove nonsmooth regions.

The choice of Sobel edge detection method is due to computational simplicity. Then, the detected edge pixels are further dilated using a dilation operationto get the optimal non smooth regions. Finally, we obtain a new images,that only consists of face regions.

C.Color Space

It is well established that the distribution of colors in an image is often a useful cue. An image can be represented in a number of different color space models (i.e., *RGB*, *HSV*,). These are some color space models available in image processing. Therefore, it is important to choose the appropriate color space for modeling human skin color. In this paper, we propose the use of the LO color space, the reason is twofold: first, color opponency is perceptually relevant as it has been proved that the human visual system uses an opponent color encoding and second, in this color space, the use of logarithms renders illumination change to a simple translation of coordinates.

1)LO Space

The colors are never perceived together in the human visual system. For instance, we never see yellowish-blue or reddish-green. Based on this theory, the LO is a representation of color information by applying logarithms to the opponency model so that it is simple to model illumination changes. As illumination changes, log component chromaticity distributions undergo a simple translation. These distributions are coded by using means and first –moments.

2.YCBCR Colour Space

Stated that the human skin colour has a restricted range of hues and is not deeply saturated, since the appearance of skin is formed by a combination of blood (red) and melanin (brown, yellow). Therefore, the human skin colour does not fall randomly in a given colour space, but clustered at a small area in the colour space. But it is not the same for all the colour spaces.

Variety of colour spaces has been used in skin detection literature with the aim of finding a colour space where the skin colour is invariant to illumination conditions ,The appearance of skin in an image depends on the illumination factors such as illumination geometry and colour where the image initially was captured.

Human eyes are highly responsive in identifying colour object in a wide range of illuminations. This ability is called colour constancy. According to, colour constancy is a mystery of perception. Therefore, the important challenge in skin detection is to represent the colour in a way that is invariant or not affected to the changes of illumination factors. The choice of the colour space affects greatly the performance of any skin detector, and is sensitive to changes in the illumination conditions The choice affects the shape of the skin class, the detection process, and the selection of the colour space that will be used in skin colour modeling. The different people have different skin colour appearance, but these differences lie mostly in the colour intensity not in the colour itself. That is why many skin detection methods disregard the luminance component factor of the colour space. Dropping the luminance component factor achieves two important goals; first the model will be independent of the differences in skin appearance that may arise from the difference in human race, or the difference in the lighting of the image; second the colour space dimensions will be reduced so the calculations would be easier.

The paper used YCbCr colour spaces. A skin colour model is created in the level of YCbCrcolour space. The reason for choosing chrolninance blue and chrolninance red (Cb and Cr) colour space instead of YCbCr is to eliminate the affect of illumination changes by using Y component Classification using only pixel chrominance Cb and Cr (pure colour) skin segmentation may become more robust to lighting variations if pixel luminance is discarded. The classification is also to narrow the search and speed up the calculation in detecting the skin face regions.

D.Input – Rgb Image

RGB color model is an additivecolor model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue.

The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors.

E.Histogram-Based Methods

Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. Color or intensity can be used as the measure.

A refinement of this technique is to recursively apply the histogram-seeking method to clusters in the image in order to divide them into smaller clusters. This is repeated with smaller and smaller clusters until no more clusters are formed. One disadvantage of the histogram-seeking method is that it may be difficult to identify significant peaks and valleys in the image. In this technique of image classification distance metric and integrated region matching are familiar. Christo Ananth et al. (8.) proposed a system which uses intermediate features of maximum overlap wavelet transform (IMOWT) as a pre-processing step. The coefficients derived from IMOWT are subjected to 2D histogram Grouping. This method is simple, fast and unsupervised. 2D histograms are used to obtain Grouping of color image. This Grouping output gives three segmentation maps which are fused together to get the final segmented output. This method produces good segmentation results when compared to the direct application of 2D Histogram Grouping. IMOWT is the efficient transform in which a set of wavelet features of the same size of various levels of resolutions and different local window sizes for different levels are used. IMOWT is efficient because of its time effectiveness, flexibility and translation invariance which are useful for good segmentation results.

Threshold With Smoothed 2-D Histogram: Human skin color varies greatly between different ethnicity. Nonetheless, skin appearance in color images can also be affected by illumination, background image, camera characteristic, etc. Therefore, a fixed or pre learned threshold for detecting skin boundaries is not a feasible solution. In ourapproach, we employ an online dynamic approach as to calculate the skin threshold values on the face images,. The assumption is that the face and body of a personalways share the same colors. However, instead of using the1-D histogram, we introduce a 2-Dhistogram with smoothing densities . In thispaper, the feature vector for the smoothed 2-D histogram, ,is represented by the combination of and Gaussian model.The smoothed2-D histogram-based skin segmentation at pixel is

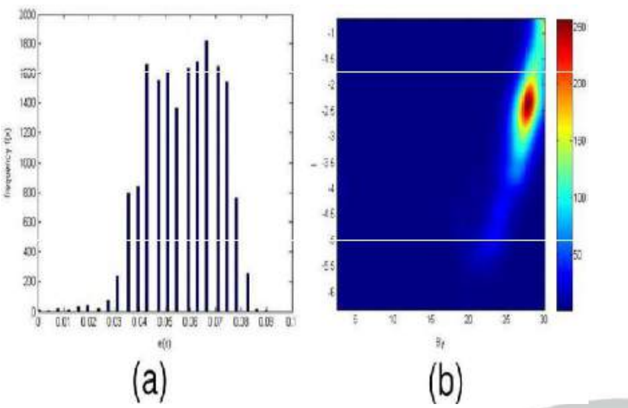

Fig.5. (a) and (b) Histograms of 1-D and 2-D: (a) as only one channel withFrequency at y axis and (b) has two different channels of the same color spaceon _ axis and y axis.

F.Gaussian Model

The Gaussian model is a sophisticated model that is capable of describing complex-shaped distributions and is popular for modeling skin-color distributions. The threshold skin-color distribution in the 2-D histogram is modeled through elliptical Gaussian joint probability distribution

where is the color vector of is the mean vector, and is the diagonal covariance matrix, respectively. refers to the mixing weights, which satisfy the constraint .

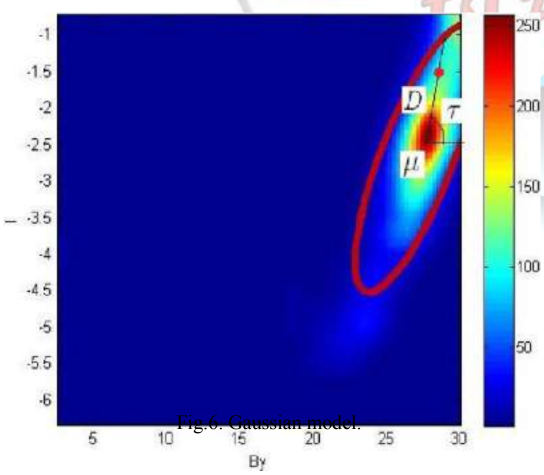

Fig.6. Gaussian model.

The result of Gaussian model-based skin detection, , can be obtained by using the center of the Gaussian model, while is the angle between axis and line . Let be the coordinate of pixel and is positioned on the red dot along line. Distance of and angle are calculated .

where and are the distances between and center, at axis and axis, respectively.

G.Fusion Strategy

In order to increase the effectiveness and robustness of the skin detection algorithm, a fusion strategy is proposed by integrating the two incoming single features into a combined single representation. Both models will vote for classification of skin and non skin pixels. This can be done by using product rule to both models matching results produced by the smoothed 2-D histogram and Gaussian model , respectively.

The combined matching results using the fusion rules can be obtained where is the selected fusion rule, which represents the product . In order to make the fusion issue tractable, the individual features are assumed to be independent of each other.

III.RESULSTS AND DISCUSSION

The smoothed and Gaussian model for automatic human skin detection in color images on Sobel edge operator. Edge detection is employed to remove non smooth regions. Here , sobel edge detection is used to removing the non smooth regions. we propose a novel human skin detection approach that combines a smoothed 2-D histogram with smoothed densities and Gaussian model are represent the skin and non skin distribution, respectively. Finally, a fusion framework that uses the product rule on the two features is employed to obtain better skin detections results.

Fig.7. Simulation of Input image

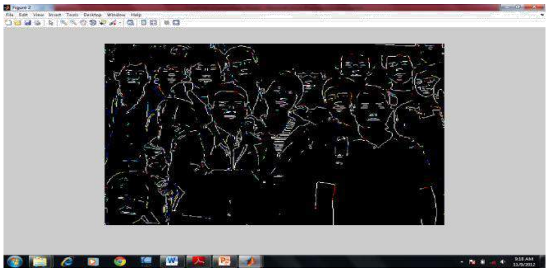

Fig.8. Simulation of Sobel edge detector

Fig.9. Simulation of Morphological operation

Fig.10. Simulation of Gaussian model

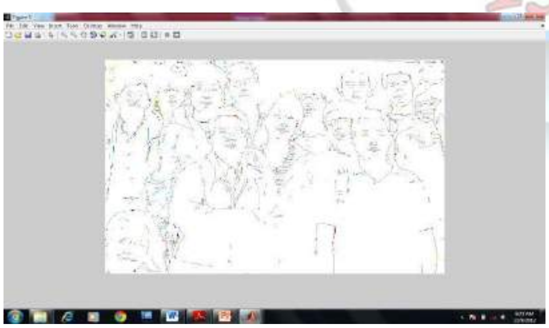

Fig.11. Simulation of Log opponent

Fig.12. Simulation of Histogram

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