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Analysis of Eye Fatigue Detection Method using Skin Color Modeling

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Abstract: In this Paper the face detection as well as eye detection method. The human skin based on the RGB component in the skin. It is helpful for programs to detect human skin after processing the image through different programs. Skin color has proven to be a useful and robust cue for face detection, localization and tracking. Image content filtering, content-aware video compression and image color balancing applications can also benefit from automatic detection of skin in images. Several computer vision approaches have been developed for skin detection. A skin detector typically transforms a given pixel into an appropriate color space, then use a skin classifier to label the pixel whether it is a skin or a non-skin pixel. A skin classifier defines a decision boundary of the skin color class in the color space based on a training database of skin-colored pixels.

Keywords: Skin Detection, eye detection RGB, YCbCr color module.

I. Introduction

Skin color and textures are important cues that people use consciously or unconsciously to infer variety of culture-related aspects about each other. Skin color and texture can be an indication of race, health, age, wealth, beauty, etc. However, such interpretations vary across cultures and cross the history. In images and videos, skin color is an indication of the existence of humans in such media. Therefore in the last two decades extensive research have focused on skin detection in images. Skin detection means detecting image pixels and regions that contain skin-tone color. Most the research in this area have focused on detecting skin pixels and regions based on their color. Very few approaches attempt to also use texture information to classify skin pixels. As will be described shortly, detecting skin pixels are rather computationally easy task and can be done very efficiently, a feature that encourages the use of skin detection in many video analysis applications. For example, in one of the early applications, detecting skin-colored regions was used to identify nude pictures on the internet for the sake of content filtering [2]. In another early application, skin detection was used to detect anchors in TV news videos for the sake of video automatic annotation, archival, and retrieval [3]. In such an application, it is typical that the face and the hands of the anchor person are the largest skin-tone colored region in a given frame since, typically, news programs are shot in indoor controlled environments with man-made background materials that hardly contain skin-colored objects. In many similar applications, where the background is controlled or unlikely to contain skin-colored regions, detecting skin-colored pixels can be a very efficient cue to find human faces and hands in images. An example in the context of biometric is detecting faces for face recognition in a controlled environment.

Detecting skin-colored pixels, although seems a straightforward easy task, has proven quite challenging for many reasons. The appearance of skin in an image depends on the illumination conditions (illumination geometry and color) where the image was captured. We humans are very good at identifying object colors in a wide range of illuminations, this is called color constancy. Color constancy is a mystery of perception. Therefore, an important challenge in skin detection is to represent the color in a way that is invariant or at least insensitive to changes in illumination. As will be discussed shortly, the choice of the color space affects greatly the performance of any skin detector and its sensitivity to change in illumination conditions. Another challenge comes from the fact that many objects in the real world might have skin-tone colors. For example, wood, leather, skin-colored clothing, hair, sand, etc. This causes any skin detector to have much false detection in the background if the environment is not controlled.

II. Skin Detection and Color Model

The study on skin color classification has gained increasing attention in recent years due to the active research in content-based image representation. For instance, the ability to locate image object as a face can be exploited for image coding, editing, indexing or other user interactivity purposes. Moreover, face localization also provides a good stepping stone in facial expression studies. It would be fair to say that the most popular algorithm to face localization is the use of color information, whereby estimating areas with skin color is often the first vital step of such strategy. Hence, skin color classification has become an important task. Much of the research in skin color based face localization and detection is based on RGB, YCbCr color spaces.

A. RGB Color Space

RGB is a color space originated from CRT (or similar) display applications, when it was convenient to describe color as a combination of three colored rays (red, green and blue). It is one of the most widely used color spaces for processing and storing of digital image data. The RGB color model is an additive color 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.

Typical RGB input devices are color TV, video cameras, image scanners, and digital cameras. Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, etc.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens as JumboTron, etc. Color printers, on the other hand, are not RGB devices, but subtractive colors devices, typically CMYK color model i.e. Cyan, Magenta, and Yellow & Key (black).

RGB color space is the most commonly used color space in digital images. It encodes colors as an additive combination of three primary colors: red(R), green (G) and blue (B). RGB Color space is often visualized as a 3D cube where R, G and B are the three perpendicular axes. One main advantage of the RGB space is its simplicity. However, it is not perceptually uniform, which means distances in the RGB space do not linearly correspond to human perception. In addition, RGB color space does not separate luminance and chrominance, and the R, G, and B components are highly correlated. The luminance of a given RGB pixel is a linear combination of the R, G, and B values. Therefore, changing the luminance of a given skin patch affects all the R, G, and B components. [1]

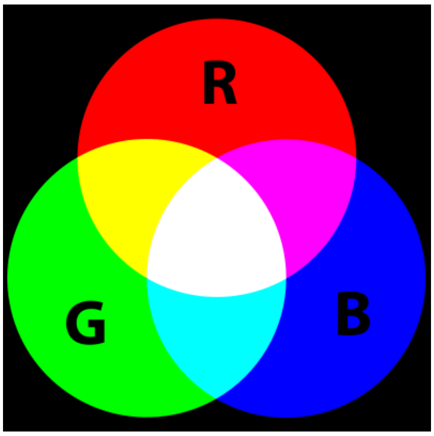

Fig 1. RGB color model

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. [8]

B. YCrCb

YCrCb is an encoded nonlinear RGB signal, commonly used by European television studios and for image compression work. Color is represented by luma (which is luminance, computed from nonlinear RGB), constructed as a weighted sum of the RGB values, and two color difference values Cr and Cb that are formed by subtracting luma from RGB red and blue components.

$Y = 0.299R + 0.587G + 0.114B$

$Cr = R - Y$

$Cb = B - Y$

YCbCr is not an absolute color space; it is a way of encoding RGB information. The actual color displayed depends on the actual RGB colorants used to display the signal. Therefore a value expressed as YCbCr is only predictable if standard RGB colorants.

The transformation simplicity and explicit separation of luminance and chrominance components makes this colorspace attractive for skin color modelling [4][5].

III. LITERATURE SURVEY

A Robust Skin Color Based Face Detection Algorithm: Sanjay Kr. Singh, D. S. Chauhan2, Mayank Vatsa, Richa Singh a comparison has been made for detecting faces in the controlled background, using skin color detection on RGB, YCbCr and color spaces. They have found that YCbCr color space are more efficient in comparison to RGB to classify the skin region[6].

Feature Points Extraction from Faces Hua: Gu Guangda Su Cheng Du provides a feasible way to locate the positions of two eyeballs, near and far corners of eyes, midpoint of nostrils and mouth corners from face image. This approach would help to extract useful features on human face automatically and improve the accuracy of face recognition [9].

A simple and efficient eye detection method in color images :D. Sidibe, P. Montesinos, S. Janaqi propose a simple and efficient eye detection method for face detection tasks in color images. The algorithm first detects face regions in the image using a skin color model in the normalized RGB color space. Then, eye candidates are extracted within these face regions. Finally, using the anthropological characteristics of human eyes, the pairs of eye regions are selected. It is based on robust skin region detectors which provide face candidates [10].

A Fast Method for Monitoring Driver Fatigue Using Monocular Camera: Hongbiao Ma, Zehong Yang, Yixu Song, Peifa Jia In this paper, a real time vision-based method is proposed to monitor driver fatigue. Firstly, the face is located by a Haar-like feature based object detection algorithm, Secondly, eye is detected and eyelid distance is computed. By analyzing the changes of the distance of eyelid along with time, they can detect driver's fatigue and issue a warning. [11]

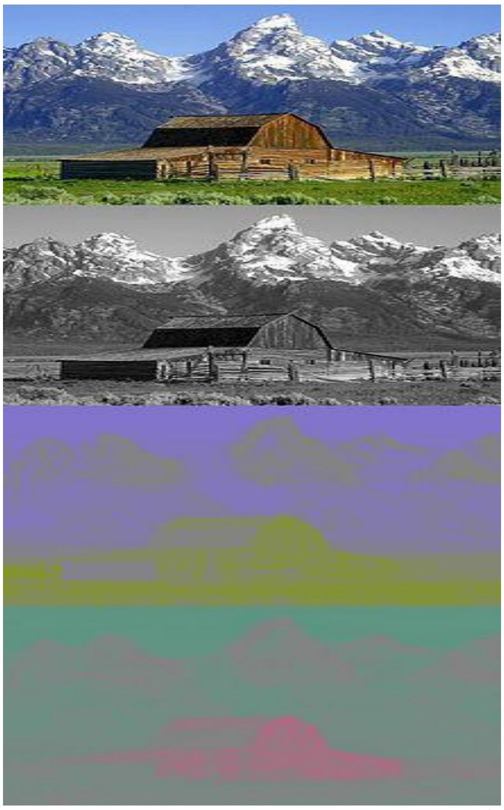

Figure 2: A color image and the Y, CB and CR elements of it.

IV. ALGORITHM

In this section we have described the two algorithms [1-2] which are based on RGB, YCbCr and a new algorithm based on the combination of these three algorithms. It has been stated that the above three algorithms work very well under the condition that there is only one face is present in the image. In the implementation of the algorithms there are three main steps viz. (1) Classify the skin region in the color space, (2) apply threshold to mask the skin region and (3) draw bounding box to extract the face image.

A. Skin Color Based Face Detection in RGB Color Space

Crowley and Coutaz [7] said one of the simplest algorithms for detecting skin pixels is to use skin color algorithm. The perceived human color varies as a function of the relative direction to the illumination. The pixels for skin region can be detected using a normalized color histogram, and can be further normalized for changes in intensity on dividing by luminance. And thus converted an [R, G, B] vector is converted into an [*r*, *g*] vector of normalized color which provides a fast means of skin detection. This gives the skin color region which localizes face. The output is a face detected image which is from the skin region. This algorithm fails when there is some more skin region like legs, arms, etc [6].

B. *Skin Color Based Face Detection in YCbCr Color Space*

We have implemented a skin color classification algorithm [8] with color statistics gathered from YCbCr color space. Studies have found that pixels belonging to skin region exhibit similar Cb and Cr values. Furthermore, it has been shown that skin color model based on the Cb and Cr values can provide good coverage of different human races. The thresholds be chosen as [*Cr1*, *Cr2*] and [*Cb1*, *Cb2*], a pixel is classified to have skin tone if the values [*Cr*, *Cb*] fall within the thresholds The skin color distribution gives the face portion in the color image. This algorithm is also having the constraint that the image should be having only face as the skin region [6].

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V. CONCLUSION

In this paper face detection techniques using skin color model are analyzed, using some simple rules derived from anthropological characteristics, eyes are selected within face regions. Comparison has been made for detecting faces in the controlled background, using skin color detection on RGB, YCbCr. This paper also made analysis of the human skin based on the RGB component in the skin. It is helpful for programs to detect human skin after processing the image through different programs.

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