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Improved Skin Detection Using Colour Space and Texture

Medjram Sofiane, Babahenini Mohamed Chaouki, Mohamed Benali Yamina

Abstract—Skin detection is an important task for computer vision systems. A good method of skin detection means a good and successful result of the system.

The colour is a good descriptor for image segmentation and classification; it allows detecting skin colour in the images. The lighting changes and the objects that have a colour similar than skin colour make the operation of skin detection difficult.

In this paper, we proposed a method using the YCbCr colour space for skin detection and lighting effects elimination, then we use the information of texture to eliminate the false regions detected by the YCbCr skin model.

Keywords—Skin detection, YCbCr, GLCM, Texture, Human skin.

I. INTRODUCTION

THE detection of the skin is an important step in many computer vision systems specially that interact with humans, include face detection [1], face tracking [2] and video surveillance [3].

Skin detection serves to separate the colour of the pixels regions corresponding to human skin. The colour generally is defined as a low level feature robust against occlusion, sensitive to variations of light and devices acquisitions. A good skin colour detector must be good against these challenges and must be able to cope with different human skin tones. In addition, most techniques for detecting skin colour can distinguish skin regions, in one hand. In other hand, they cannot eliminate other similar regions like, sand, wood, colour of clothes, etc. This produces a high number of false detections in an uncontrolled environment.

In this paper, we present a new and improved method of skin detection based on YCbCr colour space and texture.

II. RELATED WORKS

Several researchers have long confined their works to develop robust and effective methods for skin detection [4], [5], most of their techniques consisted in classifying the pixels of the image in the skin and not-skin categories based on the intensity value of the pixel. The idea behind this classification is that the skin colour of the human beings occupies a small space in the various colour spaces.

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Colour spaces are the most common method used in the segmentation of skin, include RGB, YCrCb, HSV, HIS, YUV ... etc. HSV, YUV and YCbCr colour spaces allow the separation of the colours components from the light component.

The lighting changes affect the distribution of skin colour in the picture, most colour spaces mentioned fail when the illumination changes. However, there are some methods have been used to remove the lighting effects which were employed in the service of the detection of skin, for example, the method of log- Chromaticity [6].

The log-chromaticity colour space (LCCS) is a 2D space obtained by taking the logarithm of ratios of color channels. For example, $\log(R/G)$ and $\log(B/G)$ form a 2D LCCS.

III. PROPOSED METHOD

In this paper, we use the YCbCr colour space to detect the colour of the skin in the acquired image. The YCbCr colour space is powerful against the lighting changes and it gives good results. Then, we will apply the texture information on the result obtained by the YCbCr segmentation in order to remove similar colour regions than human skin.

Fig. 1 shows the block diagram of our proposed method:

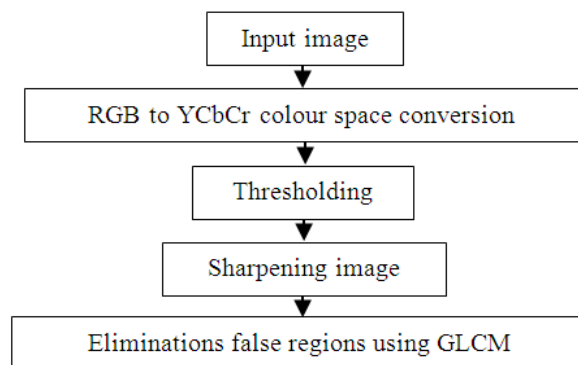


Fig. 1 General scheme of the proposed method

A. Input images

Input images used in our system were acquired from several sources include, RGB webcam images, public skin database images and public face database images.

B. Colour Skin Model

Our skin colour model was built based on the YCbCr colour space, YCbCr is a colour space widely used in video compressing like JPEG, and video acquisition. It consists in decomposing the colour under physiological criteria (Fig 2):

- Y, corresponding luminance component.

- **Cb**, represent the blue component.
- **Cr**, represent the red component.

YCbCr is a linear transformation of the RGB color space, the conversion from RGB to YCbCr is as follows:

$$\begin{bmatrix} Y \\ Cb \\ Cr \\ 1 \end{bmatrix} = \begin{bmatrix} 0,2990 & 0,5870 & 0,1140 & 0 \\ -0,1687 & -0,3313 & 0,5000 & 0,5 \\ 0,5000 & -0,4187 & -0,0813 & 0,5 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \\ 1 \end{bmatrix} \quad (1)$$

In the YCbCr colour space, the intensity information is represented by the component *Y*, this component should be neglected in the detection process of the skin, we consider only the *Cb* and *Cr* components to represent the chromatic information.

$$\text{With: } Cr \text{ and } Cb \in [16 - 240] \quad (2)$$

The intervals selected in our learning on a multitude of people from different tones of skin colour are:

$$77 \leq Cb \leq 127 \text{ and } 133 \leq Cr \leq 173 \quad (3)$$

Fig. 3 shows the image result obtained by thresholding of the *Cb* and *Cr* components.

C. Sharpening Image

Before embarking on the phase of eliminating false regions using co-occurrence matrix, it is obvious to improve the quality of image texture for a good outcome. Image sharpening is a powerful tool for emphasizing texture and drawing viewer focus [7]. Fig. 4 shows the image skin obtained by the skin model before and after applying the sharpening enhancement.

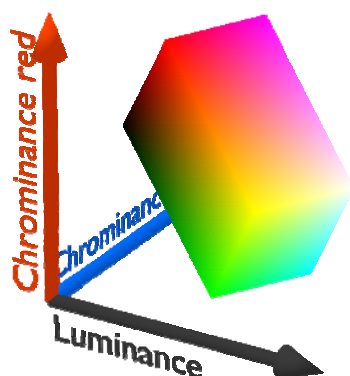


Fig. 2 Presentation of the colours in the YCbCr colour space



(a) Input image



(b) Skin colour segmentation

Fig. 3 Image skin segmentation using YCbCr colour space



(a) Result before sharpening



(b) Result after sharpening

Fig. 4 Image skin after sharpening enhancement

D.Texture

The property of texture is very important in the field of computer vision and image processing. It describes the spatial attributes of a structure of an image or of a region by the correlation between the intensities of their pixels.

False regions detected by the YCbCr skin model means that the colour property is not enough, the colour of skin is common with other regions such as: colour clothing, colour of wood ... etc. In fact, the most common regions have different textures. However, if we can establish a model of appropriate texture detection, then we can separate the objects similar to skin colour.

A statistical method of examining texture that considers the spatial relationship of pixels is the grey-level co-occurrence matrix (GLCM), also known as the grey-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix[8].

The number of grey levels of the image determines the size of the GLCM. The co-occurrence matrix of grey level can reveal many properties about the spatial distribution of grey levels in the texture image. We considered a set of features computed from [5x5] matrix: Contrast, Homogeneity, and Energy.

- Contrast

$$con = \sum \sum ((i,j)^2 P(i,j,\theta)) \quad (4)$$

- Homogeneity

$$hom = \sum \sum \{ (P(i,j,\theta))^2 \} \quad (5)$$

- Energy

$$enrg = \sum \sum ((i,j)^2 P(i,j,\theta)) \quad (6)$$

Fig. 5 shows the final image result on the sharpening skin image after texture application.



(a) Image with false skin regions



(b) False regions reduced using GLCM

Fig. 5 Improved skin detection using GLCM

IV. EXPERIMENTAL RESULTS

We tested our method on a hundred images selected from database of face and skin, and images from webcam. These images contain different tones of colour skin, and lighting effects.

Our method show good results in both cases, first the ordinary case when only the lighting changes appear in scene and the other, when the lighting changes appear in a scene containing regions with colours similar to the skin.

V.CONCLUSION

Skin colour is a descriptor widely used in recent applications of computer vision and image processing. Most existing skin detection methods fail when lighting conditions changes and fail in complex background environments.

In this paper, we presented a method for detecting skin colour on a variety of lighting conditions using the YCbCr colour space combined with the matrix concurrence as a texture descriptor.

The aim of this combination is to improving the skin detection process in quality result and rapidity.

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