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Hand Gestures Segmentation using CIELab Colour Space and Feature Detection (Finger Tips and Centroid)

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ABSTRACT: Color allows fast processing. Skin color is good feature for detection the human face and gestures. Skin color has proved to be useful for face and gesture detection , localization and tracking. In this paper, we proposed two models YCbCr and CIELab color space model for skin color detection. Both color space models are implemented on different backgrounds and light conditions. Under varying lighting conditions, we analyze the efficient method for skin color segmentation. We are observed from results that CIELab color space is better than YCBCr color space. It can improve the performance of face segmentation under poor or strong lighting conditions. The basis of our approach is fast segmentation process to obtain the moving hand from the whole image with CIELab color space segmentation technique, apply the morphological operations on segmentated image to remove the noise. Then calculate the fingertips and centroid of segmentated image which helps to make the hand gesture recognition in different manner.

KEYWORDS: YCbCr color space, CIELab Color Space, Skin Color Segmentation, Morphological Operation.

I. INTRODUCTION

Human computer interaction was mostly rely on mouse and keyboard to control the computer. The human computer interaction [1] research and development was therefore becoming an interest by many researchers in this recent year. There are several techniques introduced for the new epoch of human computer interaction such as face detection, speech recognition and motion gesture. The future computer or laptop may eliminate the use of keyboard and mouse by substituting with a vision-based interpretation devices. Human can communicate with many modalities, including speech, gestures, facial and body expressions. One of the interest fields is by using hand gestures to interact with computer as a non-contact human computer input process. In the human computer interaction, gesture has been used to determine various types of human hand movements to control process of computer. The hand gesture interaction with computer is an interesting part in the study of human-computer interaction [2]. The complexity of a hand set a lot of challenges to be tracked and interpreted. The fact that the different gestures complexity such as variability and flexibility of articulated hand structure, shape of gestures, real-time performance, varying illumination conditions and complex background noise. In real-time, these application require high accurate detection and recognition technique. However, the vision-based hand gesture recognition is still a challenging problem for human computer interaction.

In this research, we focus on the fundamental problem of Hand Gesture Recognition: the number of finger tips appeared in segmented hand images and centroid of hand. After solving these problem, we can track human hands in real time system and make many hand gestures for human computer interaction applications like music player, left movement and right movement of cursor etc.

The content of this paper is organized as follows. Section 2 gives the procedure of the proposed method. Section 3 shows the experimental results. The main conclusions are summarized in Section 4.

II. METHODOLOGY

The proposed methodology consists of three steps : (1) get the hand image out of a complex video sequence through the skin color segmentation method ;(2)get the contour of the hand through a serial of morphological operation;(3) detect the fingertips and centroid of hand.

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A. Skin Color Segmentation

In order to get the hand image out of a complex background, the method called skin color segmentation is applied. Many skin color segmentation algorithms have been proposed during these years for different purposes [3], [4], [4], [5] and [6]. There are many color spaces that are RGB, CIELab, YUV, YCbCr etc. All are based for segmentation process. YCbCr and CIELab color space model are purposed to get suitable result for skin color segmentation.

- **YCbCr color model**

YCbCr is an encoded nonlinear RGB signal. It is commonly used by European television studios and for image compression work.Y is the luma component defined to have a nominal 8-bit range of 16 – 235, Cr and Cb are the red-difference and blue-difference chroma components respectively, which are defined to have a nominal range of 16 240. It is constructed as weighted sum of RGB values.

$$Y = 0.299R+0.587G+0.114B \quad (1)$$
$$Cr = R-Y$$
$$Cb = B-Y$$

In contrast to RGB, the YCbCr color space is luminance independent, resulting in a better performance[4],[7].The threshold is used in our algorithm is given as

$$76< Cb <127$$
$$132 < Cr < 173$$

- **CIELab Color Model**

The three parameters in the model represent the lightness of the color (L*=0 yields black and L*=100 indicates white), its position between yellow and blue (b* negative values indicate blue and positive indicate yellow) and its position between magenta and green (**a***, negative values indicate green while positive values indicate magenta).[8]

It is based on the CIE*XYZ color space which can be derived using:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.4125 & 0.3576 & 0.1804 \\ 0.2127 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9502 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (2)$$

$$L = \begin{cases} 116 \left(\frac{Y}{Y_n}\right)^{\frac{1}{3}} - 16 & if \frac{Y}{Y_n} > 0.008856 \\ 903.3 & otherwise \end{cases}$$

$$a = 500 \left[\frac{X^{\frac{1}{3}}}{X_n} - \frac{Y^{\frac{1}{3}}}{Y_n}\right] \quad (3)$$

$$b = 200 \left[\frac{Y^{\frac{1}{3}}}{Y_n} - \frac{Z^{\frac{1}{3}}}{Z_n}\right] \quad (4)$$

III. PURPOSED METHODS RESULTS FOR SKIN COLOR SEGMENTATION

Results show that how segmentation results are differ with different background. Hand with light blue color background gives the better result with CIELab color model because of constant background. The segmentation with CIELab color model is better than YCbCr color model. YCbCr does not give more information of image after the segmentation while CIElab gives more information of image.

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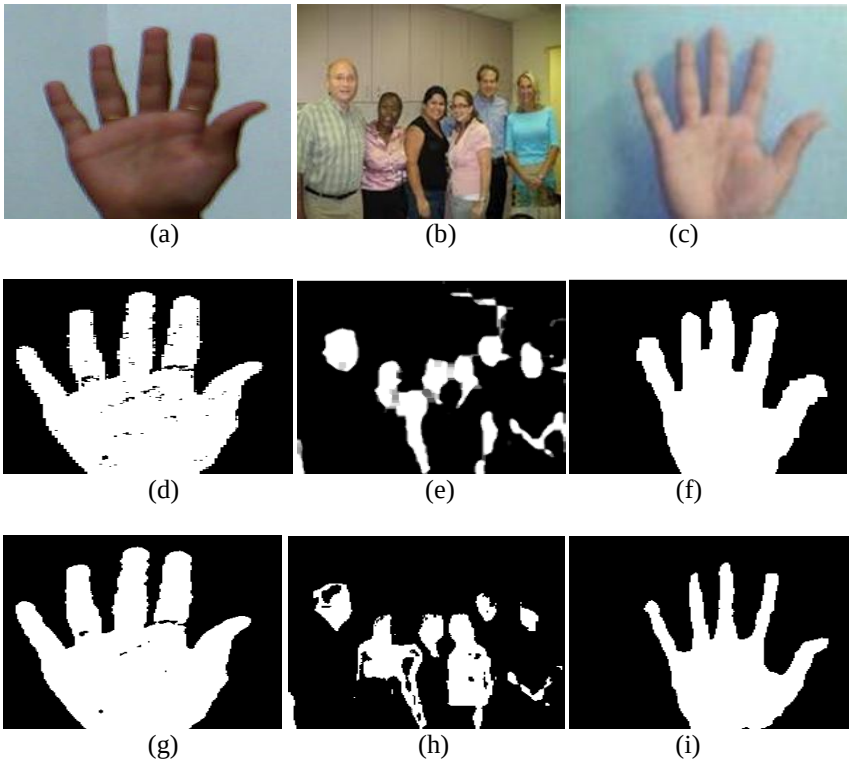

Fig. 1 (a)(b)(c) Input RGB image for skin color segmentation (d)(e)(f) Skin color segmentation with YCbCr (g)(h)(i) Skin color segmentation with CIELab

IV. PURPOSED METHOD RESULTS FOR FEATURES DETECTION

Frames from video sequence are analysed and pre processed [9].The input is RGB image which consists of red, green, and blue layers. The RGB image is taken from the video sequence RGB image is converted into Gray scale image. Gray scale image is converted into CIELab space by applying the threshold values for skin color detection. Image after CIELab color space that is converted into binary image. Morphology operation is applied to binary image. The erosion and dilation process of morphology operations are used to remove small noise holes and remove the unwanted information. we get restored hand image. Fingertips are calculated by finding the boundaries of binary image and make matrix with peak values. Removing redundant coordinates. Finding peak coordinates. Compare the current value with last and second last peak value. Detect the peak point of fingers.

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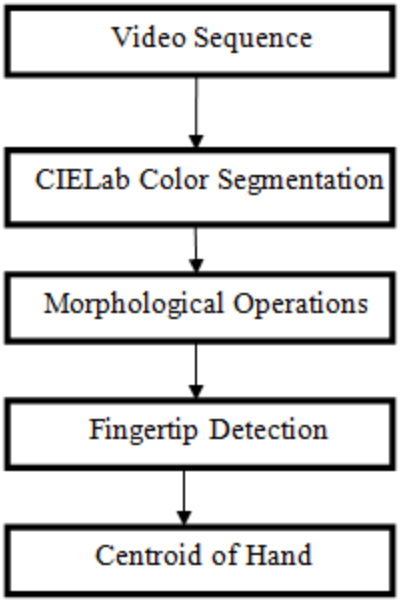
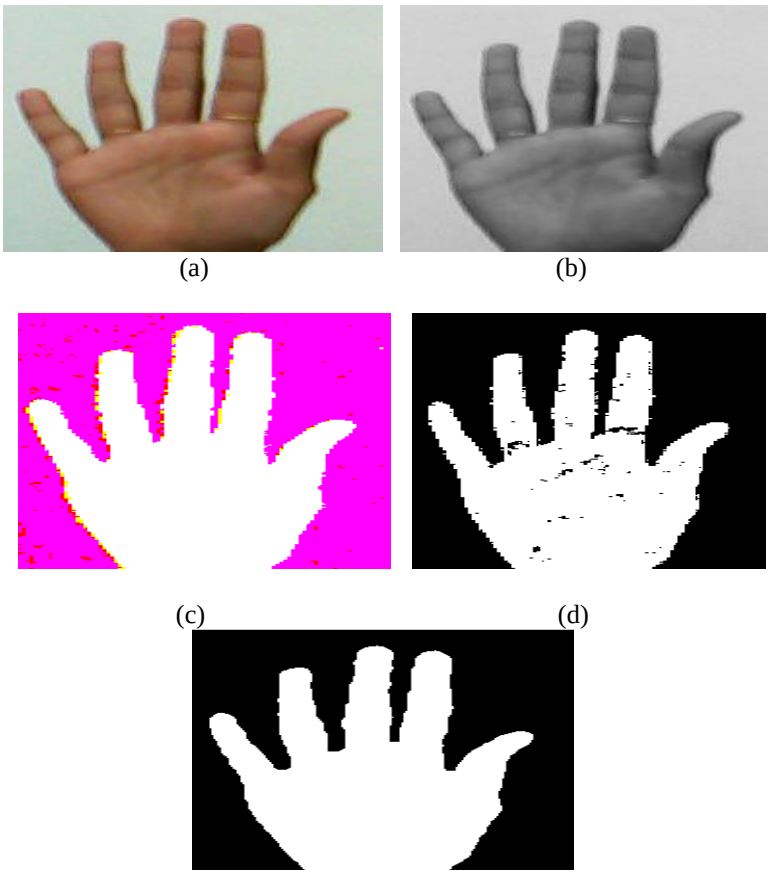


Fig. 2 Flow Diagram for the Implemented Method

A. **Hand segmentation with CIELab color space**



(a) (b)

(c) (d)

(e)

Fig. 3 (a)(b) RGB image and Gray scale image (c)(d) Skin Detection and Binary image (e) Morphological Process

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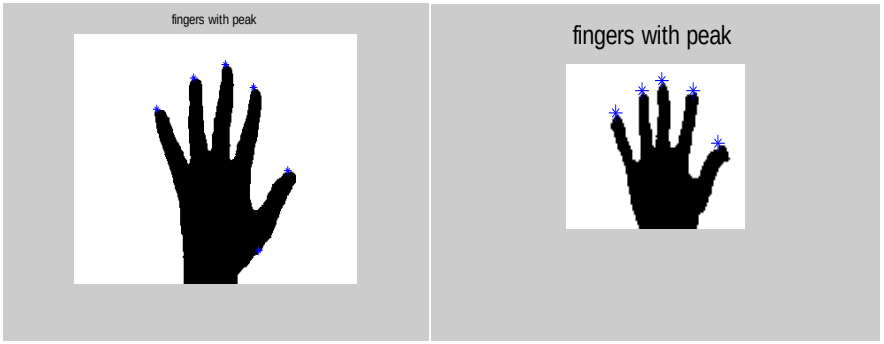
B. **Detection of Fingertips**



(a) (b)

Fig.4 (a) Fingertip (False result) (b) Fingertip (True Result)

C. **Centroid of hand**

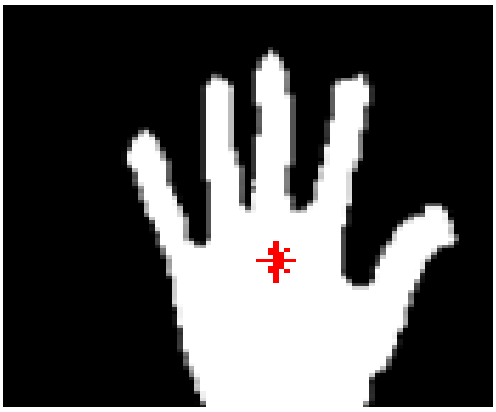


Fig.5 Hand Centroid

Our algorithm successfully detects the skin color region from the image which consists of mixed picture-graphic regions. Applied our algorithm on many images and found that it successfully detect the skin color region, detected the finger tips and centroid.

V.CONCLUSION

Done the segmentation process with YCbCr and CIELab color space model and also show the comparison of both color techniques. Observed that segmentation with CIELab color space is better than YCbCr because it gives more information than the other color space model. Fingertips detect as feature points and centroid of hand. YCbCr and CIELab color space model are implemented on image and video. Faced many problems during segmentation due to different light condition and background color. After performing these segmentation methods, concluded that CIELab is good for skin color segmentation. While calculating the fingertips, get many peak points and to minimize them applied the different algorithms on binary image of hand.

VI. FUTURE SCOPE

In future by using the feature extraction which is centroid of hand and fingertips we can perform many action such as left movement and right movement of mouse. Also make gesture based on distance calculation of centroid and index fingertip. Can make the gesture by recognize how many fingers are on the left hand and right hand side of middle finger.

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