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Automatic Segmentation of Pallet Images Using Color Statistics and Mixture Color Space

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Abstract. In this paper, we propose the mixture color model segmentation and detection method. Destination is to enable forklifts to search for pallets, but it is able to meet fully automated system with real-time. We focused on pallets for image segmentation and detection. First, we manually segmented 30 pallet images and statistics of the best color threshold, this method must find the threshold of different color space and mixture of two important color spaces containing HSV and YCbCr, we extracted the H and the Cb composition mixtures to find the best color threshold, then used the logic function to keep our information after obtaining the color image segmentation, the noise of the image must be removed, this algorithm can be used on video sequences efficiently. Finally, experimental results show that the method has effective segmentation and detection in the video sequences.

Keywords: Image Segmentation, Image Detection, Color Space, Machine Vision.

1. Introduction

Image segmentation is one of the important missions in the image process and computer vision field. In this paper, we focus on the color image segmentation, it can be divided into two categories, one is based on color space division, the other is to use clustering segmentation. In the color space segmentation method, often used in color space are RGB,YCbCr,HSV and so on. Although the RGB color space is the most direct expression of the form, it is not necessarily suitable for color analysis[1], the YCbCr and HSV have good effect in some applications and has often used algorithms in recent years[2][3][4]. The clustering method in recent years than the classic method is K-means, it is not only the data clustering classification, the color can also be classified[5].In this paper,we used color space segmentation pallet images, there are some research results to engage pallets automatically in the past[6][7], due to the pallets color being similar to skin color, we refer to the Jain AK articles as "face detection in color images" [8], this is the use of statistical skin color distribution method in different color space, to find the closest color of the threshold. In our method, we measured the pallet images in different color space to find the color of threshold. The rest of this paper is organized as follows. Section 2 describes the basic image process method in the past. Section 3 describes the proposed method, including color statistic and experimental procedure. Section 4 describes experimental results. Finally, section 5 presents our conclusions.

2. Previous Works

In the past, many of the image segmentation methods have been proposed. Edge detection is often widely used in image segmentation of the pre-treatment, edge detection is used to find the contour of objects and then find the target by other methods, there are many edge detection methods that have been proposed, such as Sobel, Canny, Prewitt operators and so on. Fig.1 shows the Sobel and Prewitt operators.

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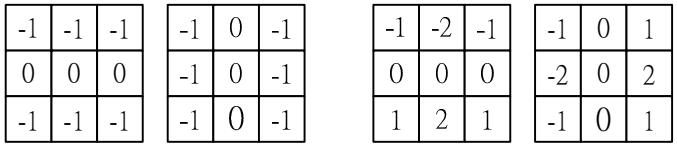


Fig.1 Edge detection operators (a) Prewitt operator (b) Sobel operator

Prewitt and Sobel operators are the most commonly used to compute the digital gradient, the Prewitt mask is easier to implement, but Sobel is better to remove noise.

The traditional color space would be divided into three categories, including the RGB, YCbCr, HSV and so on. The RGB is the most basic color, it can convert to other color spaces, the HSV color space is divided into three elements, H is the hue, S is the saturation and V is the brightness respectively, RGB to HSV mathematical is as follows:

$$H = \begin{cases} H_1 & \text{if } B \le G \\ 360 - H_1 & \text{otherwise} \end{cases} \tag{1}$$

$$S = \frac{Max(R.G.B) - Min(R.G.B)}{Max(R+G+B)} \tag{2}$$

$$V = \frac{Max(R.G.B)}{255} \tag{3}$$

Which N is the total number of pixel of the image, the N_q is the pixel intensity level the number of r_q, L is the image intensity of the total number of all possible. Assuming a threshold value K selected , the C_0 is the intensity in the (0,1,...,K-1),a collection of pixels, while C_1 is the intensity(k,k+1,...,L-1) in a collection of pixels. Otsu methods to obtain the maximum between-class variance σ_B^2 for the critical value K, this variable is defined as follows:

$$Y = 0.299R + 0.587G + 0.114B \tag{4}$$

$$Cb = -0.147R - 0.289G + 0.436B \tag{5}$$

$$Cr = 0.615R - 0.515G - 0.100B \tag{6}$$

Morphological erosion and dilation in the image processing is an important foundation. Dilation is the image of the object's mathematical computing size, the dilation is a collection of the operations defined.

$$A \oplus B = \left\{ z \middle| (B)_2 \cap A \neq \varnothing \right\} \tag{7}$$

Where $\varnothing$ the empty set and B as structural elements. The erosion is the image of objects smaller or thinner, erosion and dilation similar to the mathematical definition.

$$A \oplus B = \left\{ z \middle| (B)_2 \cap A^c \neq \varnothing \right\} \tag{8}$$

Erosion of A by B is a structural element of the origin of all the set positions, in which translation of the B and A's background does not overlap.

3. The Proposed Method

The traditional color image segmentation generally used the color space converter method. In this paper, we compute the color distribution to statistics for block of interest, we used the 30 pallet images statistics color distribution, including HSV and YCbCr color space and then extracted H and Cb component, we used the logic function separation color and then used mathematical morphological noise removal. Finally, we successfully detected images. Fig. 2 shows the basic process of the algorithm.

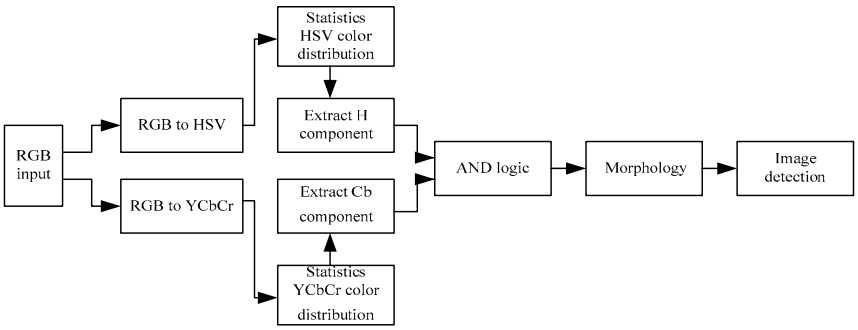
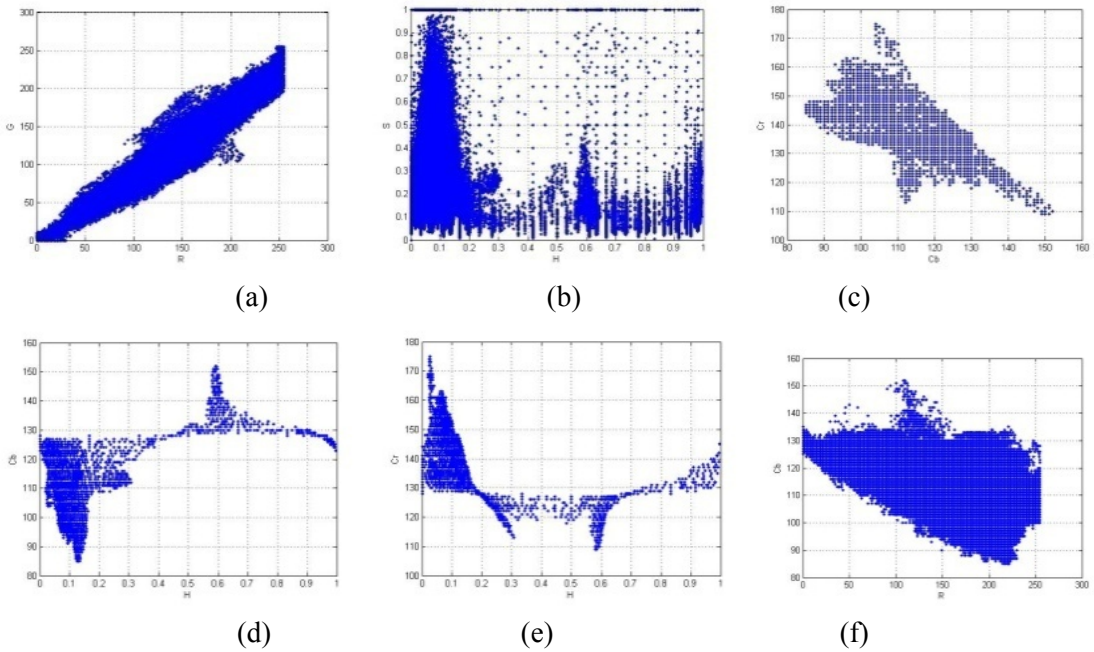


Fig. 2 Flow chart of the proposed method

We collected 30 pallet images and statistics color distribution on RGB, YCbCr, HSV color model respectively. Fig. 3 shows several kinds of different pallet image color distribution. Fig. 3 (a) (b) (f) is not a good result, because the color is too widely distributed. We decided to compare Fig. 3 (c) (d) (e) the segmentation results. Fig. 3 (c) is the CbCr color space, we can clearly see the color distribution of the threshold Cb is between 85 to 155 and Cr is between 110 to 165. .Fig. 3 (d) is the Hcb color space, H is between 0 to 0.2 and Cb is between 85 to 155, due to the color distribution is not significant, we reset the Cb between 85 to 130. Fig. 3 (e) is the HCr color space, H is between 0 to 0.2 and Cr is between 130 to 170. We can define a mathematical HCb color space as follows:

$$HCb = \begin{cases} 1 & 0 \le H \le 0.2 \; and \; 85 \le Cb \le 130 \\ 0 & otherwise \end{cases} \tag{9}$$

Comparison of experimental results in section 4.



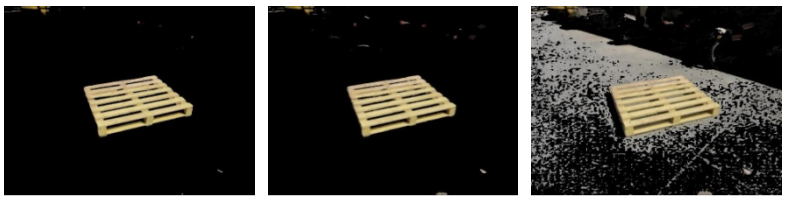
(a) (b) (c)

(d) (e) (f)

Fig. 3 The color distribution of 2D projection (a) a 2D projection in the GB color space (b) a 2D projection in the HS color space (c) a 2D projection in the CbCr color space (d) a 2D projection in the HCb color space (e) a 2D projection in the HCr color space (f) a 2D projection in the RCb color space.

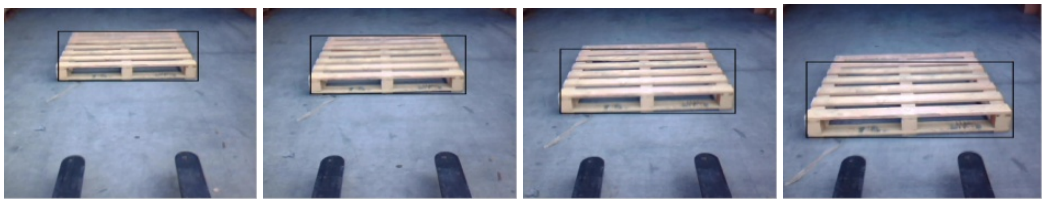
4. Experimental Results

In this section, we show experimental results of the proposed image segmentation and detection method. The proposed algorithm was implemented in MATLAB 7.6(2008a). The webcam used Logitech C200, and tested in windows XP SP3 with Intel dual core I5 CPU with a memory of 6GB. Fig. 4 shows that different color space segmentation. Fig. 5 shows the video sequences of pallet image detection.



(a) (b) (c)

Fig. 4 The different color space segmentation (a) The HCb color space (b) The CbCr color space (c) The Hcr color space.



(a) (b) (c) (d)

Fig. 5 The video sequences of pallet image detection (a) The 1th frame (b) The 50th frame (c) The 75th frame (d) The 100th frame .

5. Conclusion

In this paper, we successfully used color statistical and mixture color space application in image segmentation and detection. We have a total of six color space statistics, three color space marked effects, the effect is not significant in the other three experiments. In our approach, the image segmentation and detection was successful. In the future, we will combine the forklift to detect and meet real-time video.

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