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# Research on Hand Recognition Method Based on Markov Random Field

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**Abstract**

Now, there is a problem to satisfy the demand of flexible manufacturing systems. Human-computer interaction intelligent assembly technology is more and more attention. Gesture recognition and action understanding is the basis of human-computer interaction assembly. For this reason, the research on hand gesture recognition is carried out. Firstly, the basic according to the features of the hand skin color separation method is described in this paper. The principle of YCrCb color space and the conversion between RGB color space is illustrated. It is described how YCrCb three-channel method eliminates the influence of brightness on color, and how to identify skin color and other colors. Secondly, it is explained that the principle of Markov random field. Markov random field's application in image segmentation problem is shown. Iterative algorithm process based on Markov random field is introduced. Finally, it is described how to combine the two methods, the skin color recognition and iterative algorithm. They are combined with a small area noise removal method to achieve a better image of the hand segmentation. And segmentation results and conclusions are shown.

## 1. Introduction

With the development of recognition technology and intellectual technology, the higher demand of the intelligent and flexibility to manufacturing system has been presented. The intelligent assembly technique based on human-computer interaction get more attention. The research on gesture recognition in human-computer interaction

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intelligent assembly becomes the research hotspot. The achievement has wide application prospect in intelligent manufacturing, robot control, domestic appliance, medical treatment etc.

The research on hand recognition and Markov random field (MRF) has been done include international and domestic, and many good results have been obtained. Tan Tongde[1] choose and employ persons hand center of mass as a match point, at the same time, through image segmentation to obtain hand contour, contour convex buns feature is used to identify different gestures. Cao Qing[2] proposes a gesture recognition method based on depth image technology for hand gesture recognition in complex environments. E.D. López-Espinoza[3] improves the image segmentation algorithm effect through the analysis of the Markov random field that the use of non-homogeneous model definition of a priori function. Song Yan-tao[4] proposes a Markov random field image segmentation model based on weight of image slice. The image segmentation algorithm is established based on the model can overcome the influence of noise while maintaining image detail information. Song Aiguo[5] proposes an improved texture segmentation method based on Markov random field (MRF) model. The sensitivity of fractional differential operations to image texture details and edge contour information is used to make up the MRF features of traditional algorithms Field to image texture information. Wei Xiaoli[6] proposes a color texture feature segmentation algorithm based on the Gabor filter and Markov random field. And the image segmentation is realized effectively.

Firstly, it is presented that the skin color extraction method in YCrCb space which takes the three-channel color as the key information directly in this paper. Through the multi-sample test, the skin color threshold range is given. Then an iterative algorithm based on Markov random field is proposed. By constructing the random field, the image energy is calculated, and the iteration is replaced. With the analysis of the two methods and their own characteristics based on the results of identification, the two algorithms are combined, and the hand recognition algorithm is given. The feasibility of this method is verified by the experiment.

## 2. Recognition of skin color by YCrCb three - channel method

The traditional RGB image is obtained by superimposing three color channel values of R (red), G (green), B (blue). It gives different values for the three channels to obtain different color. All colors can be expressed as the lights mix of the three color channels. In the RGB color standard, the actual observed color is affected by the ambient light intensity. When the object to light, the actual image of the three color channel values will rise, which makes it difficult to find a suitable interval to distinguish the skin color. It is difficult to achieve effective and environmental distinction. Other color standards are required to replace the RGB standard to exclude the effect of brightness on skin color recognition.

Y is the luminance, Cb is the blue chrominance component and Cr is the red chrominance component in the YCrCb color standard. In skin color image recognition, if the YCrCb color system is used, the effect of luminance on the image can be effectively avoided by ignoring the Y channel. And the Cr and Cb value is invariant. So the same hand image can be used as the basis for skin color identification.

YCrCb image space and RGB image space conversion formula is not unique, different signals have different conversion formula. But they all have the same principle. The difference lies in the difference in coefficient Kr and Kb as below:

$$
\begin{cases}
Y = kr\ R + (1\text{-}kb\text{-}kr)G + kb\ B \\
Cb = 0.5/(1\text{-}kb) * (B\text{-}Y) \\
Cr = 0.5/(1\text{-}kr) * (R\text{-}Y)
\end{cases}
\tag{1}
$$

The value of Kr and Kb is set to Kb = 0.114, Kr = 0.299 according to the data of Resolution ITU-R BT.601[7] in this paper . In order to make Cb and Cr values in the interval [15,235], it increases of 128 on the basis of type in Cb and Cr channels while the migration processing.

$$
\begin{cases}
Y = 0.299R + 0.587G + 0.114B \\
Cb = -0.169R - 0.331G + 0.500B + 128 \\
Cr = 0.500R - 0.419G - 0.081B + 128
\end{cases}
\tag{2}
$$