EECS 332 Introduction to Computer Vision

Machine Problem 4: Color Segmentation

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1. Introduction

In the study of computer vision, segmentation refers to the partitioning of an image into non-overlapping regions. There are all sorts of methods for segmentation, including texture feature, pixel colors, pixel intensities and so on. Color segmentation is one of the effective way, which means that we segment different regions of the image based on their color. At first, we should collect lots of color sample to train our color model. In MP4, we will use 2D-histogram Model and Gaussian Model for training. Then we should set the threshold and input the test image. Finally, we can obtain the segmentation of the image.

2. Algorithm Description

We use HSV and RGB color space for 2D-histogram training:

```
function[h]=hist_RG(input_seg,histogram_rgb)
function[h]=hist_HS(input_seg,histogram_hs)
```

where input_seg is the input training dataset, histogram_hs is the initialed histogram and h is the output histogram.

Here is the core steps for 2D-histogram model segmentation using HSV space:

1) First, we should collect the training dataset. In MP4, we collect the skin region's color sample from 5 different images using imcrop function in MATLAB(as Fig1 shown).

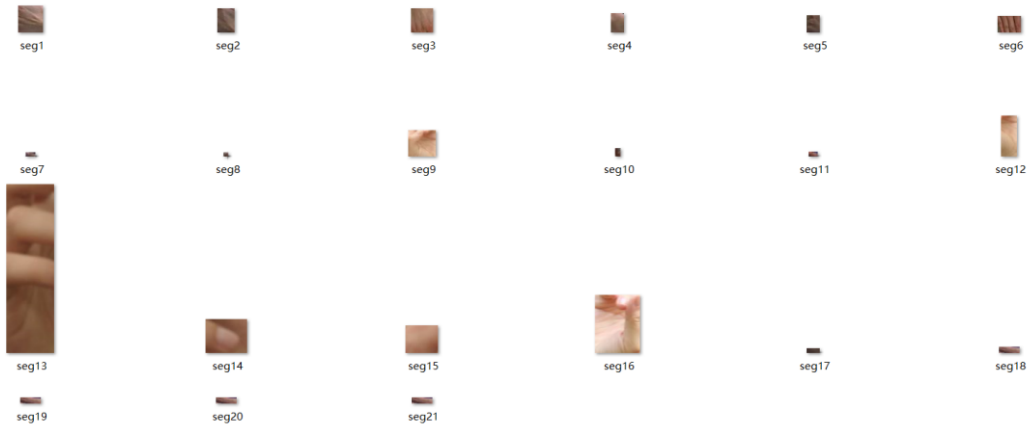

Fig.1 training color sample

Then, we should find the Hue and Saturation value of these samples by using rgb2hsv function.

2) Second, we use the training dataset to implement the 2D histogram. The value of the bin is the frequency of each (H,S) pair appearing in the sample set.

3) Then, we can input our test image into function hist_HS. In this function, we will find each pixel's H and S value. If hist_HS(H,S) is above the threshold, we can assume that this is a skin color pixel.

If we use RGB or N-RGB space for 2D-histogram, the steps are similar.

3. Result Analysis

Here are the histograms with HS and RG space:

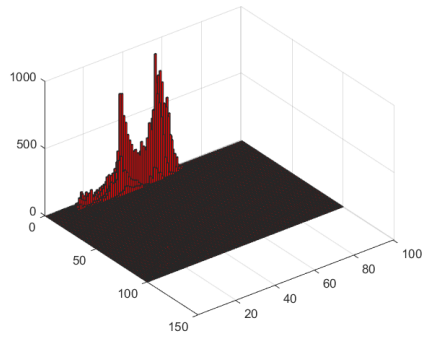

Fig.2. Histogram with HS

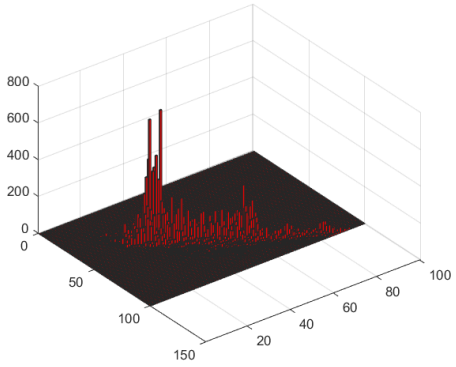

Fig.3. Histogram with RG

Here are the result of segmentations: (we set the threshold as 20)

Fig.4. Segmentation using HS histogram

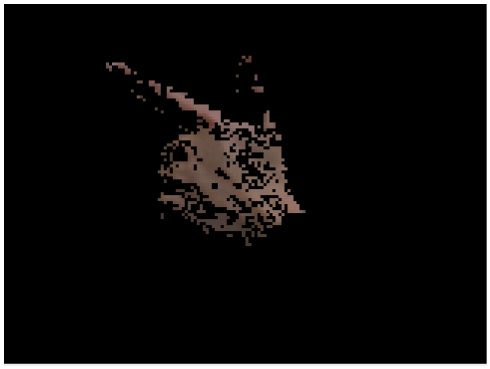

Fig.5. Segmentation using RG histogram

Fig.6. Segmentation using HS histogram

Fig.7 Segmentation using RG histogram

Fig.8. Segmentation using HS histogram

Fig.9. Segmentation using RG histogram

We also use the training detection to implement skin color segmentation in other test images:

Fig.10. Segmentation using HS histogram

Fig.11. Segmentation using RG histogram

Fig.12. Segmentation using HS histogram

Fig.13. Segmentation using RG histogram

Analysis:

1. From these testing, we can see that given the same threshold, HS histogram works better than RG histogram detection.
2. After color segmentation, the segmented region is also unperfected. We should do further job such as morphological operation and noise filtering.

3. Using Fig.10 as an example, we can’t filter the image whose color is similar to the skin color. In the bottom part of Fig.10, the color looks similar to human’s skin color. so it’ll be wrongly segmented as the skin region. To fix this problem, we can try to use other feature to implement segmentation, like texture feature.