Color Detection using Color Feature Clustering

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Abstract - In this paper, we propose a color detection method in images. It is based on K-means clustering algorithm. We first estimate means and variances of clusters in a reference image including colors of interest by using K-means clustering. We consider 2-dimensional chrominance features in YCrCb color model. The next step is to detect the color pixels of interest in an input image by the Mahalanobis distance which is statistical distance computed by the calculated mean and variance. The experimental results showed that it is very effective to detect color regions in an image.

Keywords: Color Detection, K-means Clustering, Mahalanobis distance

1 Introduction

Image segmentation and detection is an important in computer vision applications such as video surveillance, tracking, and recognition. Color is an important feature for segmentation and detection. In color image segmentation techniques [1-4], images are usually isolated as non-overlapping regions by grouping and classifying pixels using color features which are extracted from different color models such as RGB, HSV and YCrCb. In color based object detection, regions of interest which are given in advance are segmented and localized from images. In this paper, we detect color regions which are given previously by reference images from color images. We use chrominance features, CrCb-channel from YCrCb color model and K-means clustering algorithm for its distribution.

2 Our Proposed Method

Our proposed color region detection is based on K-means clustering algorithm [1]. Fig.1 shows the flowchart of our proposed method for color region detection in images. We estimate means and variances of Gaussian distributions using K-means clustering techniques over reference images including colors of interest. To calculate the parameters, we consider chrominance features, CrCb-channel from YCrCb color model. To detect color regions in an input image, we decide the color pixels of interest by Mahalanobis distance which is statistical distance based on Gaussian distributions.

![Fig. 1 The flowchart of our proposed method](image)

2.1 Feature extraction and clustering

RGB images are converted as YCrCb color space by using equation (1). We extract 2-dimensional chrominance features, CrCb-channel to estimate color distributions in reference images which are given in advance by user.

\[
Y = 0.299R + 0.587G + 0.114B \\
Cr = (R - Y)0.713 + 128 \\
Cb = (B - Y)0.564 + 128
\]

K-means clustering algorithm is a simple iterative partitioning method for clustering data. Each cluster is represented by a centroid which is a mean of the cluster data. The algorithm partitions n-feature data \( x_i, i = 1, ..., n \) into k-clusters \( c_i, i = 1, ..., k \). It finds the centroid positions \( \mu_i, i = 1, ..., k \) of the clusters by minimizing squared errors in equation (2).

\[
E(c_1, ..., c_k) = \sum_{i=1}^{k} \sum_{x \in c} dist(x, \mu_i)
\]
Where $\text{dist}(x, \mu_i)$ is the squared Euclidean distance, $\text{dist}(x, \mu_i) = (x - \mu_i)^2$ between $x$ and $\mu_i$ and $C_i$ is the set of points that belong to cluster $i$ with centroid $\mu_i$. We can compute the covariance parameters $S_i$ of the cluster by using feature data in the cluster $C_i$.

### 2.2 Color Region Classification

In an input image, to classify color pixels of interest which is given by reference images, we use the squared Mahalanobis distance which is statistical distance in equation (3).

$$D_i(x) = (x - u_i)^T S_i^{-1} (x - u_i), i = 1, ..., k \quad (3)$$

Where $\mu_i$ and $S_i$ are mean and covariance parameters in cluster $C_i$ which are calculated by K-means clustering. We classify each pixel $x$ in an input image by using the minimum distance. If the minimum distance at each pixel is greater than a threshold $T$, then we decide it as the color which is not in a reference image.

### 3 Experimental results

In our experiments, our proposed method detects the red and green color in images. Fig.2 (a) is a reference image which has 2 colors (green and red) that we want to detect. Fig.2 (b) is an input image which has 3 colors (green, red, and gray background). Fig.2(c) and Fig.2 (d) are the detected results using the threshold value $T=100$ and $T=3000$, respectively. In Fig.2(c) and Fig.2 (d), if the squared Mahalanobis distance at each pixel is greater than the threshold $T$, then it shows as the gray color, RGB=(100, 100, 100) and two colored regions show as the mean colors of the regions which are calculated by K-means clustering. We can only detect the red and green color region in the input image, but not the blue and background gray color.

### 4 Conclusions

In this paper, we propose a color region detection method. We estimate means and variances of clusters in a reference image including colors of interest by using K-means clustering algorithm. We consider 2-dimensional chrominance features in YCrCb color model. In an input image, the color pixels of interest in an input image are detected by the Mahalanobis distance. It is very effective to detect the color regions of interest given by user in an image.

### 5 References


