Additive Texture Information Extraction Using Color Coherence Vector

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Abstract: - Color histogram methods are used to so many Content-based image retrieval systems. They are simple, fast and generally insensitive to small changes in camera position. But this approach has a drawback that it does not use spatial information. Color coherence vector method includes not only spatial information that consist of coherent and incoherent vectors, but also shows superior performance to retrieve relevant images. In this paper presents modified color coherence vector. Extracting spatial information by our method is similar to conventional color coherence vector. However it makes additive texture information. Thus proposed method uses spatial information and additive texture information to retrieve relevant images from database. The experimental result showed that proposed method using additive texture information is more effective than conventional method.

Key-Words: - CBIR, Content-based Image Retrieval, Color Coherence Vector

1 Introduction

As computer performance is higher, the number of digital images is creating rapidly. Also they spread to all over the world by internet. This makes text-based image retrieval technique can not retrieve images efficiently. Annotating images using keywords is difficult to describe images precisely. And it is time consuming process. Moreover every different users may use the different keywords in annotating or searching. Thus to overcome this kind of limitations of texture-based image retrieval, Content-based image retrieval techniques have been proposed [1-4].

All the above content-based image retrieval systems use visual features to retrieve images such as color, texture, shape and so on. Among these visual features, color feature is most straightforward feature in Content-based image retrieval systems. Every objects have own color and same object tend to have same or similar color. Hence, these characteristics make image retrieval more precisely.

In the beginnings of 90's, Swain and Ballard had proposed Histogram intersection [5]. This method is simple to compute, insensitive to small changes in camera position and fast. Even though this method has many advantages, there is drawback that it dose not use spatial information.

In order to remove lack of spatial information Pass and Zabih had proposed color coherence vector method [6]. This method performs much better than color histogram. During the process each color pixels are classified by coherency. If classified region size is bigger than threshold, coherence pixels are counted as much as its size. Otherwise incoherence pixels are counted. Whether coherent or not, this process provides double color histograms. And similarity measure is conducted by these histograms.

In this paper we propose modified color coherence vector method. In order to improve retrieval accuracy we extract both of texture information and spatial information simultaneously. This method is simple also achieves performance improvement.

The rest of the paper is organized as following. In Section 2, conventional color coherence vector and the proposed method are presented. Experimental results will be described in Section 3. Conclusions appear in Section 4.

2 Color Coherence Vector

Following sections describe convectional color coherence vector and proposed method. Conventional method extracts only their spatial information such as coherence and incoherence vectors. However our approach extracts additive texture information with spatial information simultaneously. Moreover proposed method has not only benefits about space and temporal complexity, but also superior performance and accuracy to retrieve relevant images from database.

2.1 Color coherence vector

Color coherence vector is double color histograms which consist of coherent vector and incoherent vector. Classification of coherence is determined by a fixed value τ . The region is coherence if the classified region size exceeds τ , otherwise the region is incoherence. Fig. 1 depicts the steps of classification process for color coherence vector.

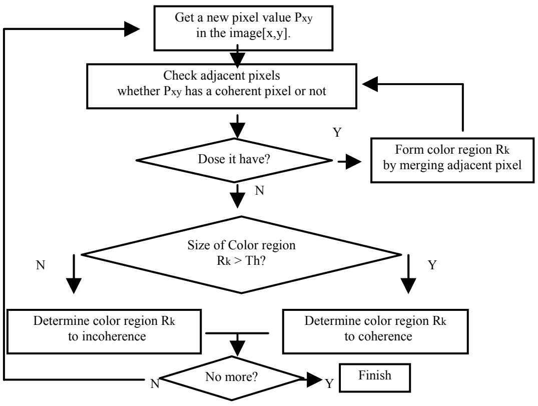

Fig. 1. Classification process of color coherence vector.

At first, conduct blur to prevent too much separation. During the process, pixel values are replaced with average value that acquired from adjacent 8 pixels. Then make both of coherence vectors and incoherence vectors by using a fixed value τ .

Let α_n denote the number of coherent pixels and β_n denote the number of incoherent pixels. Then each color is defined $\alpha_j + \beta_j$ and the color coherence vector of the image is written as;

$$< (\alpha_1 + \beta_1),...(\alpha_n + \beta_n) > \quad (1)$$

Comparing images using this vector between images I and I' can be defined as;

$$CCV_I =< (\alpha_1 + \beta_1),...(\alpha_n + \beta_n) > \quad (2)$$

$$CCV_{I'} =< (\alpha_1' + \beta_1'),...(\alpha_n' + \beta_n') > \quad (3)$$

$$\Delta G = \sum_{n=1}^{n} |(\alpha_n - \alpha_n')| + |(\beta_n - \beta_n')| \quad (4)$$

2.2 A drawback of color coherence vector

Conventional color coherence vector method uses spatial information that consists of coherence and incoherence vector. And it shows better performance than color histogram method such as histogram intersection. However it has a drawback about classification of coherence region.

As we described above, both of coherence and incoherence regions are classified by coherency of pixels in each regions. Thus, if each pixel is not only coherence but also its size exceeds a fixed value τ, they are coherence region, otherwise they are incoherence region.

In the Fig. 2, although each image is different apparently, their ratio of color composition is totally equivalent. In addition, they are coherent respectively. Thus, the outcome of color coherence vector is same. This means color coherence vector method can not distinguish some kind of pixel connections such as (a), (b), (c), (d), (e), and (f) in Fig. 2.

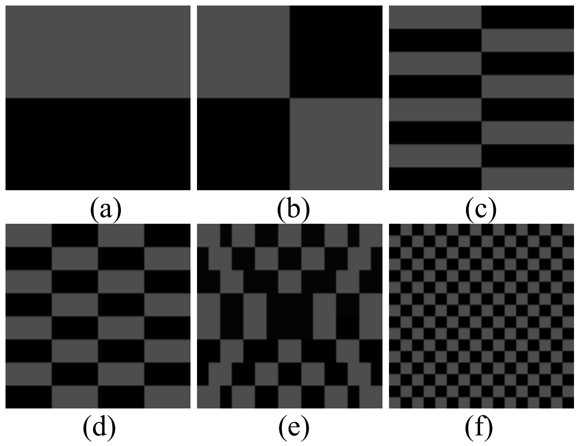

Fig. 2. Examples of patterns.

2.3 Texture with color coherence vector

In order to solve this problem we modified color coherence vector method. The flowchart of the process is depicted in Fig. 3.

During the process we count regions to compute how many regions appear in the image. This is total classified region RC by a fixed value τ . And when the color of classified region is changed, we increases CCC to compute count of color changing. So we can get a changing ratio of total regions $CRTR$ by these values. The acquiring $CRTR$ from RC and CCC is given by

$$Precision = \frac{R_r}{T}, \quad Recall = \frac{R_r}{T_r} \quad (11)$$

In the equation (11), R_r is number of relevant images retrieved and T means total number of relevant images retrieved. Also T_r is total number of relevant images in database.

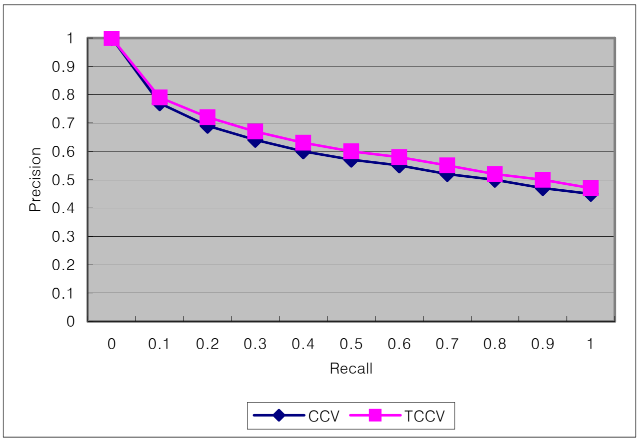

Fig. 5. Experimental result.

Fig. 5 shows the experimental result. From Fig. 5 we can see that our proposed method present a good performance and more efficient better than conventional method.

4 Conclusion

In this paper we modified conventional color coherence vector to overcome ambiguity about distinguishing of coherent pixels.

During the coherence region classification, conventional method divides color regions into coherence or incoherence. And these coherence vectors used comparing images.

In our method, we perform the coherence region classification similarly. But there is difference a fixed value τ. Reduced value τ is able to make additive texture information. As we discussed above, this additive texture information is computed simultaneously with color coherence vector. This information means changing ratio of total regions and we called CRTR. For using this, we increase the similarity when compared images have high texture distance. As a result, we can see that our method is more efficient and present better performance.

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