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Object Feature Extraction Using Double Rearrangement of the Corner Region

Ji-Min Lee[1] and Young-Eun An[2†]

Abstract

In this paper, we propose a simple and efficient retrieval technique using the feature value of the corner region, which is one of the shape information attributes of images. The proposed algorithm extracts the edges and corner points of the image and rearranges the feature values of the corner regions doubly, and then measures the similarity with the image in the database using the correlation of these feature values as the feature vector. The proposed algorithm is confirmed to be more robust to rotation and size change than the conventional image retrieval method using the corner point.

Keywords : Corner Point, Double Rearrangement, Noise-invariant Feature Vector

1. Introduction

With the development of the Internet and mobile terminals, many people can easily create and store digital images through websites, blogs, and social media. However, due to the huge amount of images, management and retrieval are becoming increasingly difficult. Accordingly, various application fields that use an image as an input have recently increased.

In particular, image retrieval has recently received considerable attention and is a field where much research is being conducted.

For image retrieval, it is essential to determine classification and key words for each image stored in the database. In the initial image retrieval, a manual indexing method was used, but there were many difficulties, such as the inefficiency of the input work and the input content being determined by the operator's subjectivity. Recently, content-based image retrieval has emerged to automatically extract feature information through image analysis such as color distribution and texture[1-7].

Content-based image retrieval calculates the similarity between images using feature values obtained through content expression elements such as color, shape, and texture. Therefore, for efficient image retrieval, effective feature extraction of the expression elements representing each image is important.

The shape feature values are very sensitive to the rotation of the image, the change in size, and an algorithm is needed to separate the objects from the background automatically or manually. To overcome this problem, Jain and Vailaya[8] applied histogram normalization or histogram smoothing method to construct edge histogram for edge components of image without separate object separation process and to consider rotation and scale change. However, this method is robust to the scale change of an image, but has a problem that other images are determined to be the same by histogram smoothing. In addition, constructing the second spline curve from the sketched image by the user, methods for retrieving has been proposed[9], but these methods are difficult in themselves and have the disadvantages of changing view points and setting object areas in advance.

In order to grasp the contents of the image, it is necessary to pay attention to the shape of the object in the image. Many images have objects that are relatively large in size, contrast with the surrounding background, and have distinct boundaries. Shape analysis and expression methods are largely classified into using shape outline information and using area inside. The method of using the outline information is to extract the

[1]SW Convergence Education Institute, Chosun University
[2]College of General Education, Chosun University, Seoseok-dong, Dong-gu, Gwangju, 61452, Republic of Korea

†Corresponding author : yean@chosun.ac.kr
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outline from the image and use the change as the feature information. The use of the information inside the region is to analyze the distribution of pixels of the entire image, and to characterize the degree of distribution of the shape, such as a method for obtaining the moment for the image[10].

By extracting and using various features described above effectively, we can increase the efficiency of content-based image retrieval. In this paper, we extract feature values of corner regions from meaningful objects of interest that can represent key image information embedded in images from images with various objects. After double rearranging the extracted feature values, we propose an image retrieval algorithm that measures similarity using the correlation of these feature values as a feature vector. This paper is organized as follows. In Chapter 2, we propose a new algorithm that retrieves the shape by extracting the corner region feature values of the object of interest. In Chapter 3, we simulate the proposed algorithm and analyze the results. And in chapter 4, we conclude.

2. CBIR Using Feature value of the Corner Region

In this paper, we propose a retrieval method that extracts edges and corner points of the image and rearranges the feature values of the corner regions doubly, and then measures the similarity with the image in the database using the correlation of these feature values as the feature vector.

Figure 2.1 above is a flowchart of the proposed algorithm.

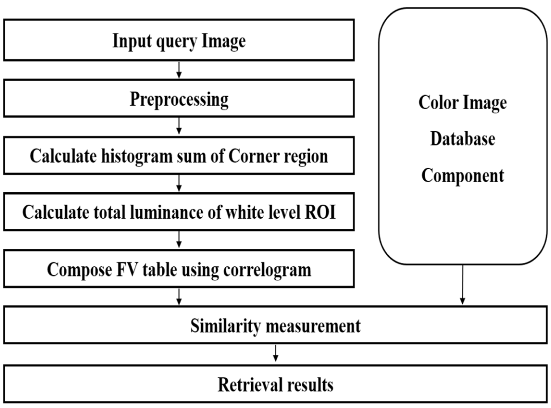

Fig. 2.1. Proposed algorithm flow chart.

2.1. Preprocessing

The edge of the first image is extracted as a preprocessing process. Then we extract the corner points from the edge image. Figure 2.2 shows the process of extracting the edge of the image, and Figure 2.3 shows the process of extracting the corner points.

2.2. Extract Total White Level Pixel Value of the Corner Points

In order to extract the feature value of the corner region, the corner points are summed by Equation 2.1. The threshold value of the corner area is calculated by Equation 2.2, and the white level is calculated.

$$Sum_{hist} = \sum_{i,\, j=-1}^{1} f(x+i\,,\, y+j) \tag{2.1}$$

$$WL = \sum_{i,y=-1}^{1} f(x+i, y+j) \quad if \begin{cases} f(x+i, y+j) >= Mean & 1 \\ f(x+i, y+j) < Mean & 0 \end{cases} \tag{2.2}$$

In here, $Mean = \sum_{i,j=-1}^{1} f(x+i, y+j)/9$

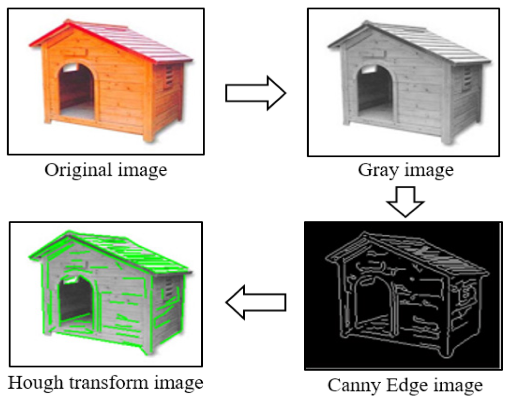

Fig. 2.2. Edge detection.

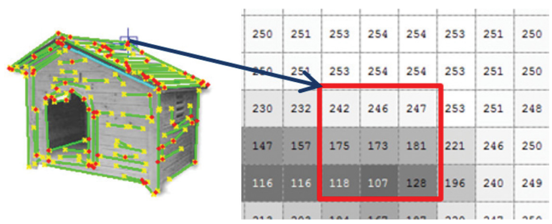

Fig. 2.3. Corner point detection.

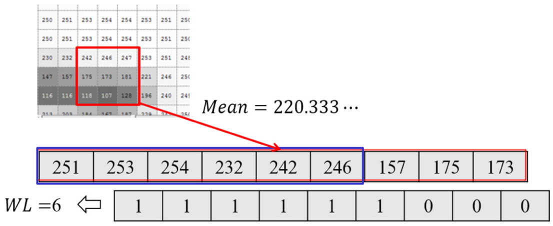

Fig. 2.4. White level pixel value extraction of the corner region.

Table 2.1. Feature table

0	0	1	0	0	0	2,039 ~ 2,295
0	5	2	0	0	0	1,784 ~ 2,040
1	2	4	0	1	0	1,529 ~ 1,785
1	2	10	3	2	0	1,276 ~ 1,530
1	0	8	5	1	0	1,021 ~ 1,275
0	1	2	3	3	0	766 ~ 1,020
0	0	0	1	0	0	511 ~ 765
0	0	0	0	0	0	256 ~ 510
0	0	0	0	0	0	0 ~ 255
7	6	5	4	3	2	Sum of Histogram / Count of WL

Then, rearrange the corner areas as shown in Figure 2.4 by the white level calculated in Equation 2.2.

2.3. Compose Variance Feature Vector

Using the sum of the corner areas obtained by Equation 2.1 above and rearranged corner region obtained in Figure 2.4, the feature table is constructed as shown in Table 2.1 below.

3. Simulation

The algorithm proposed in this paper is experimented using MATLAB 9.3 software for various images. In addition, we used the house image constructed in the database for accurate experiments, and compared and analyzed for the performance evaluation with the object corner maximum value technique proposed by Park et al[11]. In the experiment, images similar to the query images were made with the appropriate number of images. The stored data is not calculated separately when another query image is input later, and only the query image is calculated, and the result images are derived by comparing similarity measurements using the feature values of the data.

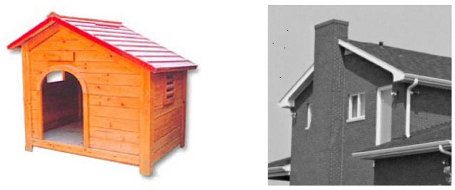

Fig. 3.1. Query images.

In this experiment, the query images are all analyzed in the same state. To test the accuracy of image retrieval, each query image is rotated and resized. In order to measure the performance of the algorithm proposed in this paper, we used the image with a clear contour of the object as shown in Figure 3.1 as the query image.

Three query images were used, and each query image had similar images that fit the query image in databases. For evaluating the proposed content-based image retrieval system, we compare the proposed system with precision and recall by using existing algorithms.

Figures 3.2 and 3.3 show simulation results when Figure 3.1 is used as a query image. Compared to the conventional algorithm, the search order of the wrongly detected image is lower, and the search for the image with the scale change and the rotated image is better.

To analyze the efficiency of content-based image retrieval, two performance measures are commonly used: Recall and Precision. Recall is the ratio of images retrieved from the image related to the query in the image database, and Precision represents the ratio of images related to the query among the retrieved images.

Recall and Precision can be defined as in Equation 3.1 below.

$$\mathrm{Recall} = \frac{\mathrm{Retrieval}\ \&\ \mathrm{Relevent}}{\mathit{Total}\ \#\ \mathit{of\ relevant}}$$
$$\mathrm{Precision} = \frac{\mathrm{Retrieval}\ \&\ \mathrm{Relevent}}{\mathit{Total}\ \#\ \mathrm{of}\ \mathit{retrieved}} \qquad (3.1)$$

The results of measuring search performance using the house image as the query image are shown in Table 3.1. As shown in Table 3.1, the proposed algorithm rearranges the corner points obtained and uses the correlation of the feature values as feature vectors, indicat-

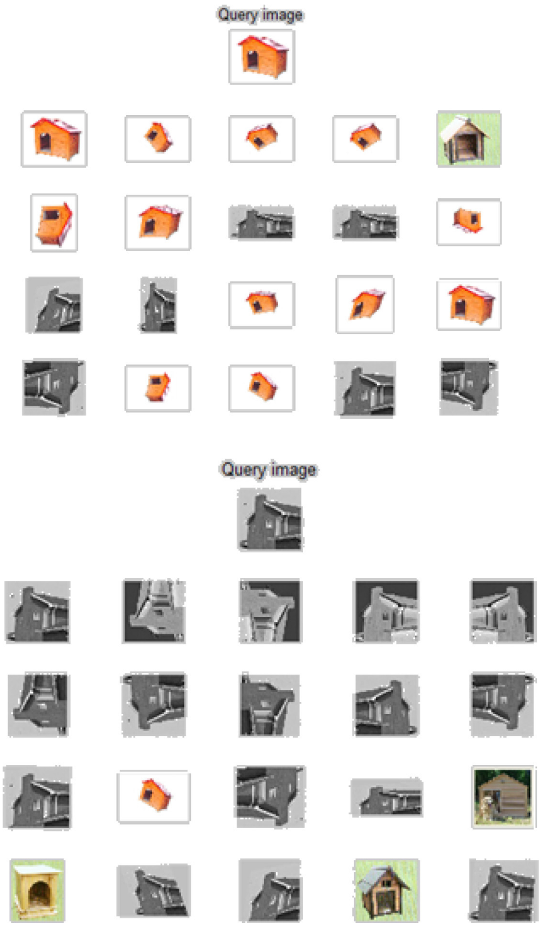

Fig. 3.2. Results of the object corner maximum value technique.

ing better performance in detecting images related to query images than conventional algorithms using the maximum value of the corner points

This simulation shows that the proposed algorithm is better fit and search rate than the existing algorithm by improving Recall by 9% and Precision by 7%.

4. Conclusion

In this paper, we propose a simple and efficient retrieval method that extracts edges and corner points of image as attributes of shape information, rearranges feature values of corner regions doubly, and then uses correlation of feature values as feature vectors. In order of operation, given the query image, the edge and corner

Fig. 3.3. Results of proposed algorithm.

Table 3.2. P & R comparison

	Existing method	Proposed method
Recall	0.8	0.89
Precision	0.56	0.63

points of the image are extracted by preprocessing. After calculating the sum of the corner points and the threshold value in the extracted corner area, the white level value is obtained using the threshold value.

Then, after rearrangement using the two feature information thus obtained, a feature table is constructed and similarity is measured.

The proposed algorithm proves the simplicity of the algorithm and the search efficiency through simulation. As a result of comparing Recall and Precision, the proposed algorithm is 9% higher in Recall and 7% higher in precision than the conventional algorithm using the corner point.

The proposed image retrieval method using the double rearrangement of the feature values of the corner region can be used to construct an optimal database by increasing the accuracy and reducing the retrieval time in image retrieval based on shape information. I think it will be able to use it as a basic system for building a content-based retrieval system.

Acknowledgments

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