Classification of identified images using several image identification methods

Akira Uchida, Kiyoshi Nishikawa, Hitoshi Kiya
Department of Information and Communication Systems, Tokyo Metropolitan University
E-mail: uchida-akira@sd.tmu.ac.jp

Abstract

In this paper, we propose an image classification method which enable us to classify the images identified using several image identification methods. We show that the trace transform, phase-only correlation (POC), and identification using DCT coefficient signs identify the images at different level. The proposed method allows a more accurate image classification by combining the three identification methods.

Keywords: CBIR, signature, image retrieval

1. Introduction

The amount of images and videos are rapidly increasing because of the widespreading of personal computers and mobile phones. On the other hand, the problems such as data replication or infringement of copyright and portrait rights. Therefore, the methods for identifying similar images and classifying those identified images are required. In this paper, we propose a technique that can classify identified images using several methods that identify similar images.

2. Identification methods

In this paper, we briefly review the three identification methods used in the proposed method to classify identified images.

2.1 Identification using Trace Transform

The first method is identification using the trace transform[1]. By performing types of geometric transformation (e.g. rotation, expansion, reduction, translational displacements), trace transform enables us to identify images based on the value of invariant features.

Figure 1 shows the process of feature extraction using the trace transform. Three transformations (trace functional, diametric functional, circus functional) are performed on each image, and then, the triple feature is extracted. When the values of triple feature extracted from images are close, then there is a similarity between them.

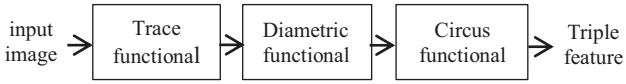

Fig.1 The process of triple feature extraction

2.2 Phase-only correlation(POC)

The second method is POC[2]. POC is a kind of correlation and can estimate translational displacements, rotation, or scaling with subpixel accuracy between two images. POC of two images is denoted by $r(x,y)$, and a sharp peak at one point in $r(x,y)$ indicates that there is a similarity. Then the coordinates of $r(x,y)$ express the translational displacement, and that at $r(0,0)$ a peak indicates that geometric transformations were not performed.

2.3 Identification using DCT coefficient signs

The third method is image identification using DCT coefficient signs[3] for judging whether the image is obtained by compressing the same original image in JPEG format directly or not. In this method, JPEG image is first decoded, then the 8×8 DCT is applied to the decoded image, and the DCT coefficient signs can be extracted. The sign of DCT coefficient remain the same when only the scalar quantization is performed, so DCT coefficient signs are robust to compression. When σ is defined as a similarity level between two images, then σ can be calculated by comparing the DCT coefficient signs. Only when compared to the JPEG compressed images of the same original image directly, similarity level σ equal to "1".

3. Classifying identified images

Here, we discuss classifying identified images using the image identification methods described in section 2.

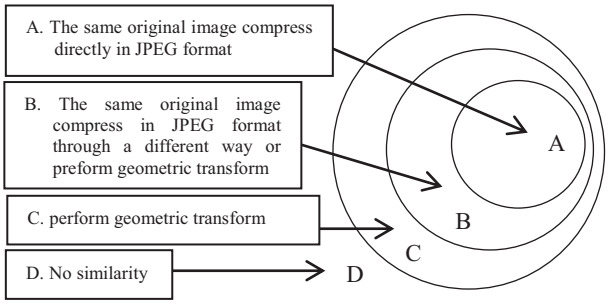

Fig. 2 Relationship between two images

Figure 2 shows that relationship between two images calculated by the three identification methods. The difference between A and B is whether the image is obtained by compressing the same original image in JPEG format directly or not. The difference between B and C is that the image is compressed using different compression methods, or whether the image is geometrically transformed (e.g. translational displacement) or not. The difference between C and D is that the image is geometrically transformed and whether the image remains some part of the original image or not.

4. Simulation

4.1 Simulation Conditions

Image database used in the simulations was video sequence "Soccer" (resolution : 780×1280), which consists of 780 frames. All frames were then JPEG compressed with two different Q-Factors, 50 and 100 respectively. Totally there were 1560 images. The query was frame no.100 with QF 50 and compared with frames no.100-104 and 700 with QF 50 and 100 respectively. Figure 3(a) shows a query image and 3(b) shows one of the compared images as an example.

4.2 Result of Classifying identified images

Table 1(a) shows the result of the comparison with frame no.100-104 and 700 with QF 50. (x, y) is the coordinate of maximum value and $r(x, y)$ is the maximum value in POC plane. "Nothing" means that there is no sharp peak in POC plane and no similarity between images. Two methods using trace transform and POC identify frames no.100-104. However, the method using DCT coefficient signs does not identify frames no.101-104. Therefore, the original image of frames no.101-104 is not the same as that of the query image, and frames no.101-104 are classified in B. All identification methods do not identify frame no.700. Therefore, there is no similarity between the query image and frame no.700, and frame no.700 is classified in D.

Table 1(b) shows the result of the comparison with frames no.100-104 and 700 with QF 100. As well as

Table 1. The result of the comparison with database

(a) Database: frame no.100-104,700, QF 50

Frame No.	Triple feature	(x, y)	$r(x, y)$	Σ	Class
100	7.175E+08	(0,0)	1	1	A
101	7.176E+08	(0,0)	0.4986	0.9970	B
102	7.174E+08	(0,0)	0.3436	0.9854	B
103	7.173E+08	(0,1279)	0.2235	0.9648	B
104	7.177E+08	(0,1278)	0.2033	0.9333	B
700	9.610E+08	"Nothing"	"Nothing"	0.5723	D

(b) Database: frame no.100-104,700, QF 100

Frame No.	Triple feature	(x, y)	$r(x, y)$	Σ	Class
100	7.182E+08	(0,0)	0.4058	1	A
101	7.184E+08	(0,0)	0.3590	0.9983	B
102	7.182E+08	(0,0)	0.2682	0.9816	B
103	7.180E+08	(0,1279)	0.1975	0.9789	B
104	7.184E+08	(0,1278)	0.2016	0.9570	B
700	9.610E+08	"Nothing"	"Nothing"	0.5711	D

(a) frame no. 100, QF 50 (b) frame no. 700, QF 100

Fig.3 Example of frames

QF 50, two methods using trace transform and POC identify frames no.100-104 respectively. Frame no.100 with different QF is identified by the method using DCT coefficient signs. Therefore, the original image of frame no.100 with QF 100 is the same as that of the query image and, frame no.100 with QF 100 is classified in A. Also, flames no.101-104 and 700 with QF 100 are classified. Class matches the correct relationship between images and the proposed method can classify the identified images more accurately.

5. Conclusion

Classifying the identified images using several identification methods is proposed. Each identification method identifies the images in different degree. Combining three identification methods classify identified images more accurately.

References

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