Visual Identifier which is robust and invariant to image modification

Weon-Geun Oh*, A-Young Cho**, Ik-Hwan Cho**, Jun-Woo Lee**,
Dong-Seok Jeong**, Hae-Kwang Kim***

*한국전자통신연구원(owg@etri.re.kr), **인하대학교, ***세종대학교

1. Introduction

In this paper, we explain the performance of a local region descriptor by adapting the algorithm which is robust to image modification including geometrical transformation. Section 2 and section 3 describe the extraction process and the matching process of the proposed descriptor. Experimental results are shown in section 4. Section 5 concludes this paper.

2. Feature Extraction

Firstly, interesting points to be center position of each local region are derived by Harris corner point detection method. The described local region is fixed by setting its size. Then finally, the local gradient histogram is extracted from each region as a main descriptor. The extracted histogram and x, y location information of each local region are binary encoded to be used in retrieval system.

2.1 Interesting point detection

In this paper, interesting points are used to determine local regions to be described. Harris corner point detection method is used.

In input image, pixels having corner response value, R over threshold are classified as candidates for interesting points. And final Harris corner points are derived by selecting local maxima pixels from candidate points around 35 by 35 neighborhood. Fig. 1. shows the result of Harris corner point detection.

2.2 Determination of local region

After obtaining interesting points as the location of local regions, we need to determine the size of local region. The final image descriptor is derived only from this limited local regions. Other regions not selected as interesting points are excluded from the description range.

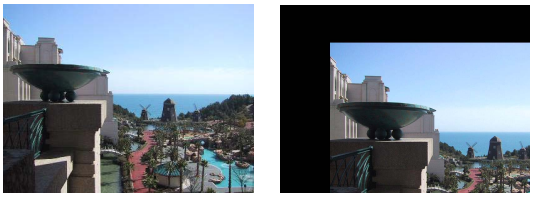
2.3 Local gradient histogram

In this chapter, we use local gradient histogram as the descriptor. Prior to real description, the local region should be normalized. The local region is smoothed using Gaussian smooth function. And then, gradient amplitude and phase for every normalized pixel is calculated.

Fig. 1. Harris corner point detection.

3. Similarity Matching

In the proposed method, additional processes including correspondence matching and RANSAC(Random Sample Consensus) are needed. Firstly, the correspondence matching finds candidate matching pairs using simple Euclidean distance between gradient histograms. And RANSAC removes outlier pairs from candidate matching pairs derived in the previous step. Finally, we can obtain similarity between two images using distance measure. Fig. 2. a,b,c,d shows the results.



(a) (b)

(c) (d)

Fig. 2. Correspondence matching and RANSAC.

4. Experiment results

The performance of the proposed descriptor and matching process is measured by average hit ratio. The number of ground truth is 15 because 14kinds of modification are used. Table 1 shows various modifications used in this paper. The modification is performed using modification software.

Table. 1. Modifications.

No.	Modification
O	Original
M_1	Brightness (+5)
M_2	Brightness (-5)
M_3	monochrome
M_4	JPEG compression (QF:95%)
M_5	Color reduction (16bit color)
M_6	Blur 3x3
M_7	Histogram equalization
M_8	Crop 90 %
M_9	Crop 70 %
M_{10}	Crop 50 %
M_{11}	Flexible crop
M_{12}	Translation 10 %
M_{13}	Translation 20 %
M_{14}	Translation 40 %

We use 200 original images. Therefore, the total number of test image set including the modified is 3,000. Feature extraction process uses all 3000 images and the matching process uses 750 (50x15=750) as query images. Fig. 5 represents our experimental results with the performance of edge histogram descriptor and the former algorithm (Local Region Descriptor (old)). In addition, Fig. 3 shows the accuracy on each modification for local region descriptor. In Fig. 3 and Fig.4, the results are almost similar.

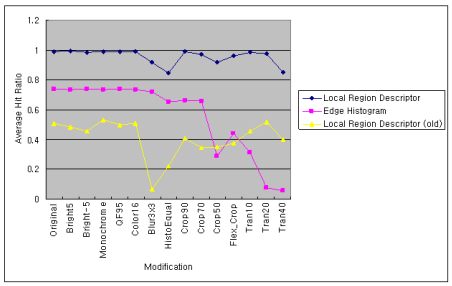


Fig. 3. Performance Test of local region descriptor.

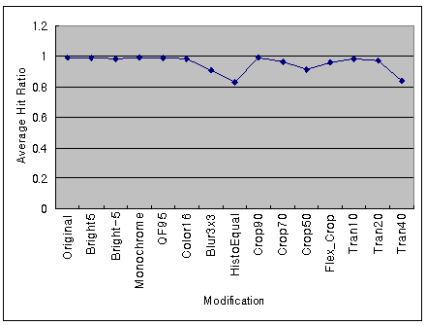


Fig. 4. Average hit ratio for each type of modification

5. Conclusion

The proposed local region descriptor shows better accuracy results for image modifications compared to the MPEG-7 Edge Histogram, but requires more computing resources. We continue to enhance the proposed descriptor.

Reference

[1]. MPEG Video Group, "Local region descriptor robust invariant geometrical transformation," MPEG Doc. No. M12816, Bangkok, Jan. 2006.