Automatic Discrimination of Photos and Computer Graphics Images

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Abstract

In this thesis, a new approach to discriminate Photos (PH) and Computer Graphics Images (CGI) is developed that is based on the discrete cosine transform (DCT) of an image, in the YCbCr color space. The statistical features extracted, have been tested in suitable databases and had given remarkable results.

Introduction

With the development of computer graphics rendering software, it has become extremely difficult to distinguish whether an image is computer generated or a natural one. Sometimes it is even impossible for a naked eye to realize if an image is a representation of real scene or not. An example of two images from the two different categories, is illustrated in Fig.1.

Figure 1: Example images from the two different categories. ***Left: CGI, Right: Photograph**. (Images from [1].)*

CGI attributes

In order to succeed the discrimination we try to exploit certain of the attributes that CGI have. These are the following:

- *Patches of uniform color*
- *Subtle color variation*
- *Simple scenes*
- *Small number of objects*
- *Additive noise to increase the levels of photorealism*

Figure 2: Example CGI possessing the afore mentioned attributes. (Images from the database of [1])

Feature Extraction Process

The proposed method is a statistical method that has its roots in JPEG compression, i.e. it utilizes the DCT of 8x8 non-overlapping blocks of an image in the YCbCr color space. The features used, are the first four statistical moments (mean, variance, skewness and kurtosis) of two sets of error signals, where the first set contains prediction errors for various DCT coefficients, while the second set considers errors in the spatial domain, at different compression scales. The feature extraction process is illustrated in Fig.3.

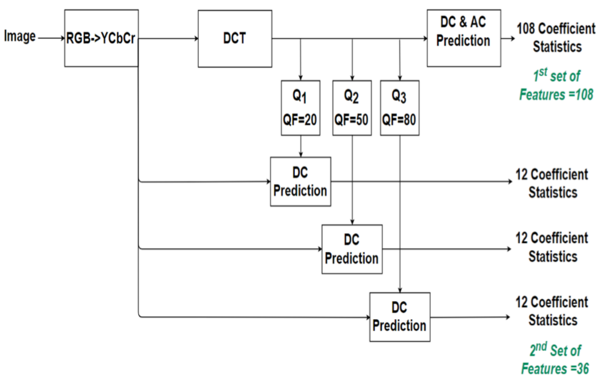

Figure 3: Feature Extraction Process

Experimental Results

The image database that was used for the experiments, was provided by E. Tokuda et al. [1] and includes 4,850 PH and 4,850 CGI. For the classification, we employed a SVM with radial basis function (RBF) kernel. The image database is randomly partitioned into training and testing sets with a ratio of 80%. For the reliability of the results we created 10 random splits and the average accuracy of each class is shown in the Table 1:

	PH(%)	CG(%)	Accuracy(%)
1st set of Features	92.35	91.04	91.7
2nd set of Features	89.64	87.02	88.3
Joint set of Features	93.59	92.69	**93.14**

Table 1: Experimental Results for Different Set of Features

Furthermore we wondered which of the color channel gives us the best accuracy. The results are shown in Table 2:

	PH(%)	CG(%)	Accuracy(%)
Y	84.25	82.3	83.28
Cb	92.32	90.38	91.35
Cr	91.76	91.53	91.65
Y Cb Cr	93.59	92.69	**93.14**

Table 2: Experimental Results for Different Color Channels

References

1. E. Tokuda, H. Pedrini, and A. Rocha, "Computer generated images vs digital photographs: A synergetic feature and classifier combination approach," *Journal of Visual Communication and Image Representation*, vol.24, pp. 1276-1292, Nov 2013.
2. S. Lyu and H. Farid, "How realistic is photorealistic?" *IEEE Transactions on Signal Processing*, vol. 53, no2, pp. 845-850, Feb 2005.