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**Research Article**

# IDENTIFYING NATURAL IMAGES AND COMPUTER GRAPHIC IMAGES BASED ON TEXTURE FEATURE HOMOGENEITY

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**A B S T R A C T**

Classification of natural images and computer graphic images is widely used in the applications which include video indexing, animal classification, flower classification, web and many other fields. Since, computer graphic images possess high realism it is very difficult to distinguish from natural images by a naked eye. This paper presents a novel identification scheme to classify natural images and computer graphic images based on texture feature homogeneity. Experimental results show that, the proposed scheme can achieve an average identification accuracy of 93.30% by using KNN classifier.



## INTRODUCTION

Due to the advancement in digital technology, digital images have been used in the various fields like medical imaging, web searching, entertainment, education, video indexing, image indexing and many more. Digital images are categorized into two classes viz., photographic images and computer graphic images. Photographic images are basically referred to natural images taken by digital cameras. Computer graphic images are generated by graphic software packages such as MAYA, Adobe Flash, AutoCAD, etc. With the rapid growth in the information technology and computer graphic image rendering software enable the user to create more photorealistic images, which cannot be easily differentiated from natural images with naked eyes. Computer graphic image can be claimed as natural image and used in illegal activities. This has become an important problem of criminal investigation and intelligent image analysis and has attracted many researchers to build classification system which effectively classifies images into 2 kinds [1]. Classification of natural images and computer graphics images is done based on the following features [2]:

***Physical features:*** Physical features are the features introduced by digital camera such as chromatic aberration, Photo Response Non-Uniformity (PRNU) and pattern noise, etc.

***Statistical features:*** Statistical features deal with contents of an image. Standard deviation, mean, variance, etc are some of the examples of statistical features.

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***Geometric features:*** An image is constructed using geometric entities such as lines, points, arcs, circles, polygons, etc and features are corners, blobs and edges etc.

This paper presents classification of natural images and computer graphic images based on texture feature homogeneity.

### *Related work*

Various authors have proposed classification algorithms to discriminate Natural Images (NI) and Computer Generated (CG) images. A survey of few prominent research works is presented in this section. Wu *et al*. used histogram bins of first order and second order differences of images for classification. A dataset containing 2000 JPEG images which includes 1000 natural images and 1000 computer graphic images and achieved average identification accuracy of 95.2% for red channel, 95.1% for green channel and 95.3% for blue channel [3]. Li *et al*. presents a multiresolution approach based on local binary pattern. 95.1% of classification accuracy is achieved with a dataset of 12500 images containing 6250 images from each category [4]. Peng *et al*. proposed to use multifractal spectrum features of Photo Response Non Uniformity (PRNU) for identification of NI and CG images. An average classification accuracy of 98.99% is obtained with 8 dimension features. A dataset of 4000 images including 2000 NI and 2000 CG images were used for the experiment [2]. Lv *et al*. employ a blind identification scheme based on fractal dimensions. A dataset of 1600 JPEG images are collected from Columbia University and other websites where each category includes 800 images and an average detection accuracy of 92% is achieved [5]. Peng and Zhou proposed a scheme based on the features of the impact of Color Filter Array (CFA)

interpolation on the local correlation of Photo Response Non Uniformity (PRNU). A dataset consists of 2400 JPEG images which include 1200 NI and 1200 CG images were used in the experiment. 9 feature dimensions are extracted and 99.43% of average classification accuracy is obtained [6]. Peng *et al*. made an analysis of textural difference between residual images of NI and CG images. 9 dimensions of histogram features and 9 dimensions of multifractal spectrum features were extracted to represent their difference. 6 dimensions of fitness features are combined to form 24 features. An average identification accuracy of 98.69% is achieved with a dataset containing 6000 JPEG images which includes 3000 NI and 3000 CG images [7].

***Feature Extraction***

Texture feature Gray Level Co-occurrence Matrix (GLCM) is used to compute homogeneity from the gray image. Homogeneity measures closeness of the distribution of elements in the GLCM to the GLCM diagonal. Formula used to extract the homogeneity is given below.

$$\sum_{i,j} \frac{p(i,j)}{1+|i-j|}$$

***Experiments***

***Dataset***

In the experiments, an image dataset which consists of computer graphic images and natural images containing 1560 JPEG images, where each category contains 780 images. All images are downloaded from the publicly available dataset "Columbia University Image Database". Images are randomly chosen for training and testing.

***KNN Classifier***

K nearest neighbor algorithm is a non-parametric technique used for classification and regression. It is based on feature similarity. On querying similarity between test data and training set records is calculated to predict the class of test data.

***Experiment Process***

The process of classifying NI and CG images can be summarized as follows:

**Step 1:** Input an image, CG image is labelled 1 and natural image is labelled 2 respectively.
**Step 2:** Divide an image into 3X 3 sub blocks.
**Step 3:** Convert each sub block of an image into binary image and extract the texture feature.
**Step 4:** Find the minimum, average and maximum homogeneity value from 3X3 sub blocks.
**Step 5:** 80% of the images are randomly selected for training and the remaining 20% are used for testing. KNN classifier is used for classification.

***Experiment Results***

To ensure the reliability of the classification results, training and testing set are iterated through 5, 10 and 15 times by varying the number of nearest neighbors from 1 through 3 and the results are shown in Table 1. As seen in Table 1, better average identification accuracy of 93.30% is obtained when training and testing set are iterated 10 times.

**Table 1** Classification results

| Iterations | Number of nearest neighbors | | |
|---|---|---|---|
| | K=1 | K=2 | K=3 |
| 5 | 93.07 | 92.11 | 78.01 |
| 10 | 93.30 | 92.82 | 79.67 |
| 15 | 93.09 | 92.30 | 78.93 |

## CONCLUSION

Based on the characteristics of texture feature homogeneity, a novel classification scheme is proposed to distinguish natural images and computer graphic images. From each image, minimum, average and maximum homogeneity values are extracted. Experimental results show that, an average identification accuracy of 93.30% is achieved.

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