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AN APPROACH FOR STATISTICAL TEXTURE DESCRIPTION

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ABSTRACT

The Texture Analysis method, called "X-Matrix" method used to differentiate the image based on the textures. The Classification accuracy of the method was evaluated using statistical method. The features extracted from this method provide complete texture information about an image and it showed excellent performance in discriminating texture images. In this work, the performance of the above method has been tested on six different images and gray levels. Some of VisTex natural texture images have been used for evaluating the performance of the features in the characterization and discrimination of the texture aspects of image. The classification accuracy of the method was evaluated using the statistical method. It was observed that the method is more sensitive to the image size than the gray level. For a specific image size, with increase in gray level the classification accuracies decrease largely. Based on this method we can easily classify the images. Promising results are obtained and presented in this paper. However, for a specific gray level, the increasing image size showed significant effect on the classification accuracy.

1.INTRODUCTION

Although there is no strict definition of the image texture, it is easily perceived by humans and is believed to be a rich source of visual information- about the nature and three dimensional shapes of physical objects. In many image areas, such as geosciences and remote sensing, medical imaging, defect detection, document processing and image retrieval texture analysis plays an important role. Surface structure formed by uniform or non-uniform repeated patterns is known as Texture[1,2,3,4]. The patterns also can be the perceived surface such as mineral, metal or wood which have tactile properties, or they could be reflectance on a surface such as color. In texture analysis, there are related issues such as texture classification, texture segmentation, and texture synthesis which are concerned by many researchers.
Generally speaking, textures are complex visual patterns composed of entities, or sub patterns that have characteristic brightness, color, slope, size etc. thus texture can be regarded as a similarity grouping in an image (Rosenfeld 1982). There are four major issues in texture analysis: (i) Feature extraction (ii) texture discrimination (iii) Texture classification (iv) shape from texture. Feature extraction is the first stage of image texture analysis. Results obtained from this stage are used for texture discrimination, texture classification or object shape determination. This work is confined mainly to feature extraction and texture discrimination techniques using texture primitives [5, 6].

Texture primitives or texture elements (texels) are building blocks of a texture. Texture can be described by the number and types o primitives and by their spatial relationships.

In this paper, firstly, it has a brief introduction of how image processing is used to identify the different textures of the images. Figure 1 depicts how the image is being processed initially and finally the classification is done for the acquired image.

Feature extraction is the procedure of generating descriptions of an object in terms of the measurable parameters. The extracted features represent the relevant properties of the object, and may be used with a classifier to assign the object to a class or grade. The general task of texture measurement and evaluation has long been the topic of intense research in the image processing community. It is commonly agreed that textural features play a fundamental role in classifying objects and outlining the significant regions of a gray level image.

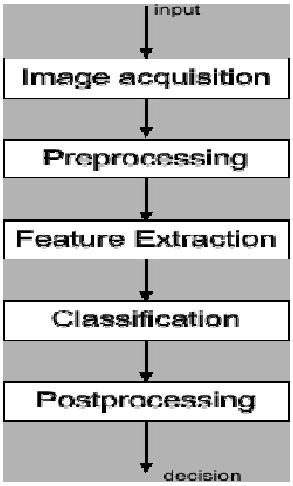


Fig 1: Processing of Image

Texture Spectrum has been used for the analysis of the all types of the images especially in segmentation and classification of the problems. In Texture Segmentation, the pixels are grouped together to form regions of uniform texture, where as in the Texture Classification, the problem is to classify the instance if the textured region in an image as one of a set of all classes. For performing Texture Spectrum there are two methods majorly. They are Statistical and Structural.

In Statistical method, texture is considered as the repetition of some basic primitive patterns with a certain rule of the placement. Fourier analysis is the well-known Structural method for determining the primitives and the displacement rules, where as in Statistical Method the stochastic properties of the spatial distribution of gray levels in the image are characterized.

The most common features used in the practice are those derived from the "Gray Level Co-Occurrence Matrix" called as "X-Matrix". We use this approach for obtaining the different textures as output.

2.PROPOSED SYSTEM

The Proposed system is the "X-Matrix" method useful for the classification of the images based on their textures. This method constructs the diagonal matrix and the pixel graphs to classify the image pixels.
The Texture Analysis method, called "X-Matrix" method used to differentiate the image based on the textures. The Classification accuracy of the method was evaluated using statistical method. It was observed that the method is more sensitive to the image size than the gray level. For a specific image size, with increase in gray level the classification accuracies decrease largely. Based on this method we can easily classify the images.

MERITS

1. Can easily segregate the different kinds of textures.
2. Easy understanding of texture of the image.
3. Can obtain gray values more accurate.

3.METHODOLOGY

The most common methods for extracting features are Gray Level Co-occurrence Matrix (GLCM) and the Texture Spectrum (TS) methods. Recent researches developed another method called "X-MATRIX" method by utilizing the properties of both GLCM and TS methods.

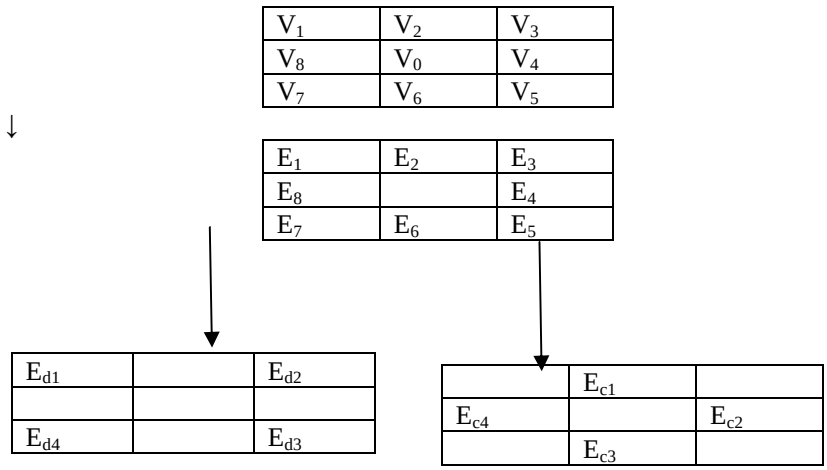
The GCLM method of texture analysis characterizes the spatial relationship between a pixel and the neighboring pixel at a given specific distance and angle. It has been noticed that reasonable texture information of an image can be obtained between two pixels. The TS method of Texture analysis gives the texture information using the eight neighboring pixels around the central pixel. The level of this information depends on the ordering of the neighboring pixels. A new method of texture analysis has been developed in characterizing the texture information by separating the eight neighboring pixels around the central pixel in a neighborhood of 3 x 3 pixels.

In this X-Matrix method first we get the entire pixels of the image into an array. Then pull out all the possible 3x3 matrices from it. Then for each matrix we must follow the same procedure as we mentioned below. The texture information can be obtained from the mathematical model representing the two groups. The diagonal elements are arranged in the texture unit. Each element of the texture unit has one of the three possible values assigned values 0,1and 2. The properties of the combination of all the four elements in each group results in 81(3^4) texture units in total. These two-new texture units are called cross-texture units(ctu) and the diagonal-texture units(dtu) respectively. The elements in them are in the places in the cross-diagonal directions with respect to the reference central pixel. Both the texture units are labelled by using the following formula:

$$N_{ctu} = \sum_{i=1}^{4} E_{ci} * 3^{i-1} \quad (1)$$

$$N_{dtu} = \sum_{i=1}^{4} E_{di} * 3^{i-1} \quad (2)$$

Where N_{ctu} is the ctu number, N_{dtu} is the dtu number, E_{ci} is the i^{th} element of ctu set $\{E_{c1}, E_{c2}, E_{c3}, E_{c4}\}$ and E_{di} is the i^{th} element of dtu set $\{E_{d1}, E_{d2}, E_{d3}, E_{d4}\}$.



The elements in the ctu and dtu may be ordered differently. The first element of each unit may take four possible positions, giving a total of 16 (4 x 4) possible positions for both units. The values of ctu and dtu vary depending on the position of elements in the units and can label by using formulae (1) and (2). A X-Matrix obtained from these texture units with the ctu number on the x-axis and dtu number on the y-axis. This X-Matrix has the elements of relative frequencies in both texture can be extracted to give texture information about the image.

PERFORMANCE ANALYSIS

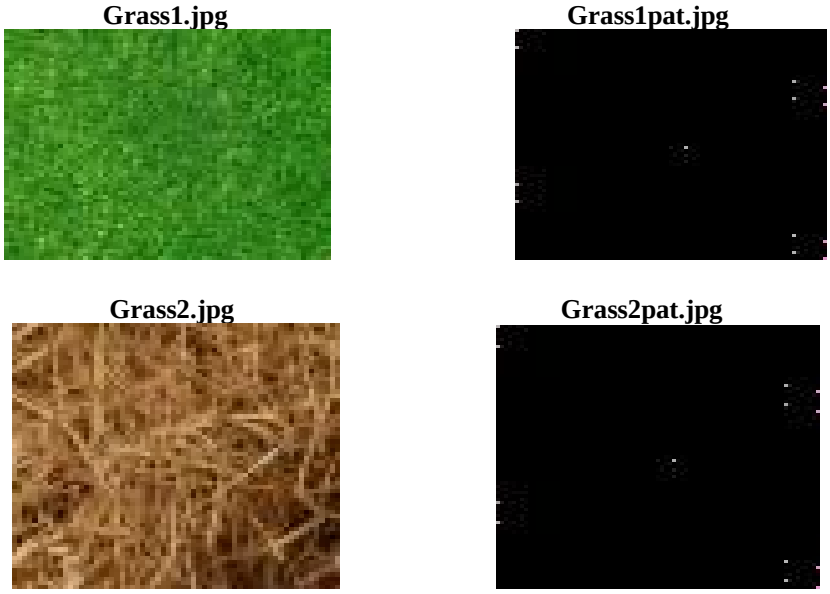


Figure2:. The change in image appearance of the same texture (left side is the grass image and right side shows the relative frequencies in the images)

We can notice that from the above Figure 2, the grass1.jpg and the grass2.jpg have the different colors but as we know that they are of same kind and irrespective of the colors they are visible to us. They show the same pattern which was practically shown in the grass1pat.jpg and grass2pat.jpg. Hence from this we can differentiate the images of same kind irrespective of what is the color of image if and only if the size of the image is same (for example it is 3kb both).
Consider one more example in Figure 3, water images. We can see the patterns as pasted below.

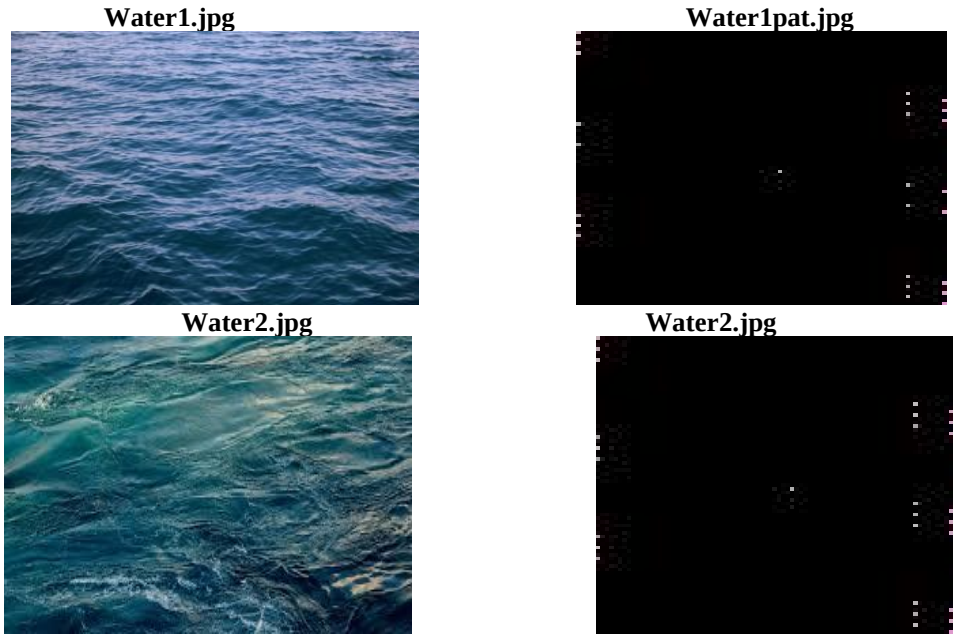


Figure 3: The change in image appearance of the same texture (left side is the water image and right side shows the relative frequencies in the image)

The other example we have considered is wall images. We can notice that the wall image patterns shown differently because the differences between the sizes of the images differ more. So, the main condition to achieve this was to maintain the size of the image. By this example we can prove that the increase in the size of the image, the classification accuracy increases based on the gray levels.

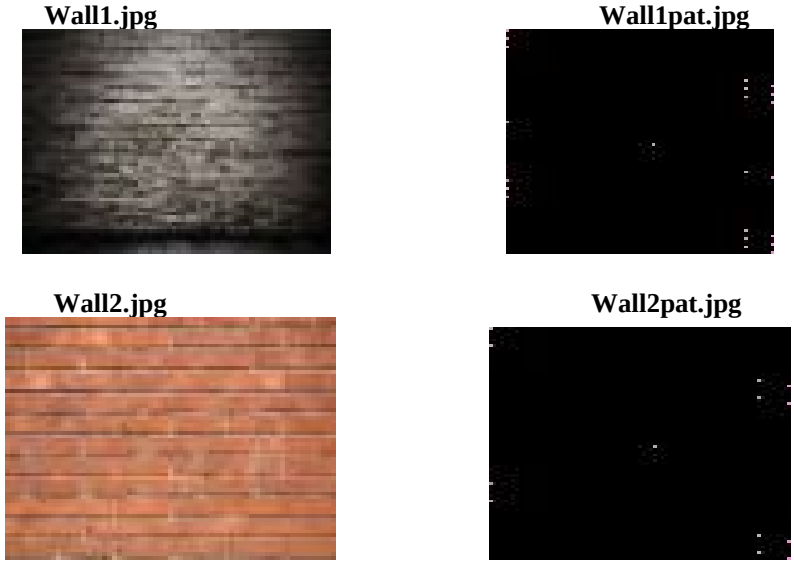


Figure 4: The change in image appearance of the same texture (left side is the wall image and right side shows the relative frequencies in the image)

Finally, we can say that this method was more sensitive to the size than the gray level of the image.

4.CONCLUSION

This paper put forward a new method of feature extraction to describe image features of identical group. This method can express the texture primitives of identical group of images to be same. We can conclude that "X-Matrix" is the powerful method in-order to extract the features of the images where we can find out how the pixel differs from one image to another image. It is very useful in differentiating the pixels of the same type of images. Using this we can easily segregate the images by extracting the features of each image and compare it through their gray levels. We use this technique because it is used to identify the gray levels of each image which is highly used to differentiate the images which are looking as equal to our naked eye.

The "X-Matrix" of texture Analysis was tested with the different images and their gray levels. It was observed that for a specific gray level, the classification accuracy increase with the increase in the size of the image and the method is more sensitive to image size than the gray level of the image. The results clearly indicate the efficacy of the proposed method compared to other methods when tested on three different groups of texture images. All the three groups maintain their homogeneous gray level pixel texture primitive pattern as the results indicate. Thus it reduces the overall complexity in texture discrimination of images.

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