STONE TEXTURE CLASSIFICATION AND DISCRIMINATION BY EDGE DIRECTION MOVEMENT

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Abstract

Texture discrimination is the rich field in the area pattern recognition and pattern analysis. The texture classification is the one of the major field in texture discrimination. In this paper derive an approach for texture group classification based on the direction movement. The edge movements are identified in each 3×3 window of the texture image. Based on the edge direction movements the texture images are categorized. Two texture groups used in this paper. Texture group 1 consists of Bark, Sand, Raffia and Pigskin images and Straw, Bsand, Wgrain and Grass image are treated as texture group2. In this paper, Horizontal, Vertical direction and also Right, Left Diagonal Edge direction movements are identified.

Key Words: *Edge Direction movements, texture classification, pattern recognition, texture group*

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1. INTRODUCTION

In Image processing, Texture analysis and classification plays a major role. The major areas are stone texture classification, medical imaging, quality of stone detection, character recognition, object detection and retrieval and remote sensing. Originally, texture mainly consists of uniform and non uniform patterns. The texture classification has two major problems such as extracting the best features for texture description and selecting the best classification technique for classification with selected features.

So many approaches are available in the literature for texture classification. The first and top most approach is Local Binary Pattern (LBP) approach [1, 2]. But LBP approach has some disadvantages like if the central pixel value changes at least 1, the LBP value is drastically changes. Some other approaches are Texture classification by statistical learning from morphological image processing [3], Texture classification based on random threshold vector [4], The main goal of texture classification is to classify images into homogeneous classes that have the same textural pixels [5]. Ashour et.al used Multidirectional Gabor filter to classify Engineering Machined dataset into six classes based on Principal Components Analysis (PCA) and Artificial Neural Network classifier [6]. A number of algorithms are designed for feature extraction of a texture image from the past 2 decades [7, 8]. Other approaches for texture classification are marble texture description [9], skeleton extraction of texture [10], long linear patterns using wavelets [11] wavelet transform [11, 12, 13]. And Gabor filters [14].

Study of patterns is the one of the popular approach for analysis and categorization of stone texture images. Recently, textures are classified into various categories by using various pattern methods like long linear patterns [15, 16], edge direction movements [17] preprocessed images, marble texture description [18] and Avoiding Complex Patterns [19], Textures are also illustrated and classified by using various wavelet transforms: one based on primitive patterns [20], and another one based on statistical parameters [21].Ravi et al proposed a stone texture classification method based on texture patterns [22].

From the above literature, observe that no study has attempted to classify the textures with good classification results by using edge movement pattern approach with good classification results. The present paper attempted to classify the texture images based on Edge Movement approach.

The paper is organized as follows. Section 2 describes methodology for texture classification. The section 3 describes experimental results and analysis of results. The conclusions are given in section 4.

2. PROPOSED METHOD: TEXTURE DISCRIMINATION USING FREQUENCIES OF EDGE MOVEMENTS

The present paper extends the concept on neighborhood and proposed a novel method of discriminating textures by using edge movement on a 3×3 window of the texture image. The edge moments of the texture image mainly consists of 4 steps. In the first step, covert the input color image into gray level buy using the HSI color model. Apply opening operation on the input image for removing the small objects from the foreground in the second step. In the third step, find the frequencies of the edge movements in each grey image. Based on the frequency occurrence of the edge movements, plot a graph for classifying the stone textures into four categories in the fourth step. The block diagram of the entire process is shown in figure1.

Step1: Color to Grey using HSI color model:
Various color models are available in the literature for image processing. Generally, the color images are represented by using RGB. Here RGB is the color components: R-Red, G-Green and B-Blue. TO achieve the better features from the color image need to convert into another model. The present paper used the HSI color model. The HSV color model also has 3 components: Hue, Saturation and Intensity. The Hue is a attribute of color which represents the dominant color component in RGB. The Saturation is an expression of the relative purity or the degree to which a pure color is diluted by white light. HSV color model describes color relationship more accurately than RGB color model.. The transformation equations for RGB to HSV color model conversion is given below.

$$V = \max(R, G, B) \quad (1)$$

$$S = \frac{V - \min(R, G, B)}{V} \quad (2)$$

$$H = \frac{G - B}{6S} \; if V = R \quad (3)$$

$$H = \frac{1}{3} + \frac{B - R}{6S} \; if V = G \quad (4)$$

$$H = \frac{1}{3} + \frac{R - G}{6S} \; if V = B \quad (5)$$

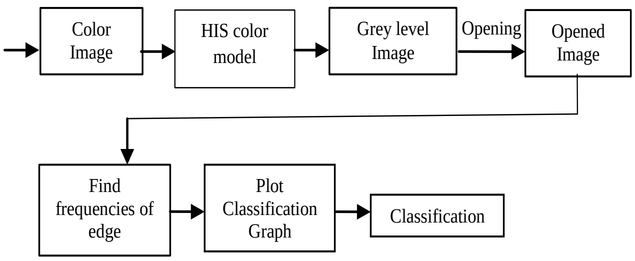

Fig -1: Block Diagram of the proposed method

The range of color component Hue (H) is [0,255], the component saturation (S) range is [0,1] and the Value (V) range is [0,255]. In this work, the color component Hue (H) is considered as color information for the classification of texture images.

Opening of the texture Image:
Opening is a morphological operation that generally smooth's the contour of an object, breaks narrow isthmuses and eliminates thin protrusions. The present study advocates a new statistical method for classification of textures on the opening of the image.

Find the Edge movement direction:
n edge is a property connected to an individual pixel and is figured from the picture capacity conduct in an area of that pixel. It is a vector variable with two segments, greatness and heading. The edge greatness is the size of the slope, and the edge course ø is turned regarding the inclination heading ψ by - 90 degrees. The inclination heading gives the course of most extreme development of the capacity. The edge movement is find out in each 3×3 window of the image. The pixel positions in each 3×3 window is shown in figure 2.

RD1	VD1	LD1
HD1	CP	HD2
LD2	VD2	RD2

Fig -2: A 3×3 window with 8-neighborhood that forms 4 directional vectors

The present paper finds out the edge movements by using the following algorithm.

Algorithm 1: Calculation of edge movement frequencies

BEGIN

Step1: Initialize FHG, FVG, FRDG and FLDG.
Step2: Find HG=|HD1-HD2| and VG=|VD1-VD2| RDG=|RD1-RD2|and LDG=|LD1-LD2|
Step3: Find MAX (HG, VG, RDG, LDG) and increase the corresponding frequencies.
If MAX (HG, VG, RDG, LDG) is equal to HG then FVG=FVG+1;
If MAX (HG, VG, RDG, LDG)is equal to VG then FHG=FHG+1;
If MAX (HG, VG, RDG, LDG)is equal to RDG then FLDG=FLDG+1;
If MAX (HG, VG, RDG, LDG)is equal to LDG then FRDG=FRDG+1;
Step4: Repeat the steps 2 to 3 for entire image on convolution basis on a 3x3 window.
Step5: G1= FHG+FVG and G2=FRDG+FLDG
Step6: Plot the graph of G1 on various textures.
Plot the graph of G2 on various textures.

END.

Based on this assumption the present study calculated the frequencies of Horizontal, Vertical, Right and Left diagonal edge direction movements, as described in the Algorithm 1.

3. RESULTS AND DISCUSSIONS

To find out the effectiveness of the proposed method it is evaluated on different texture groups the group 1(TG1) consists of Bark, Sand, Raffia and Pigskin. The frequency occurrences of the Horizontal and Vertical Edge direction movement of texture group 1 is listed out table 1 and the classification graph is shown in figure 1. The frequency occurrences of the Right and Left Diagonal Edge direction movements of texture group 1 is listed out table 2 and the classification graph is shown in figure 3.

Table -1: Horizontal and Vertical Edge direction movements are calculated after Edge sharpening for the Texture Group TG4

Sample No.	Bark	Sand	Raffia	Pigskin
1	9665	9302	10272	9041
2	9552	9531	10140	9015
3	9461	9301	9851	9146
4	9459	9349	10211	8826
5	9536	9258	9689	8935
6	9498	9240	10094	9120

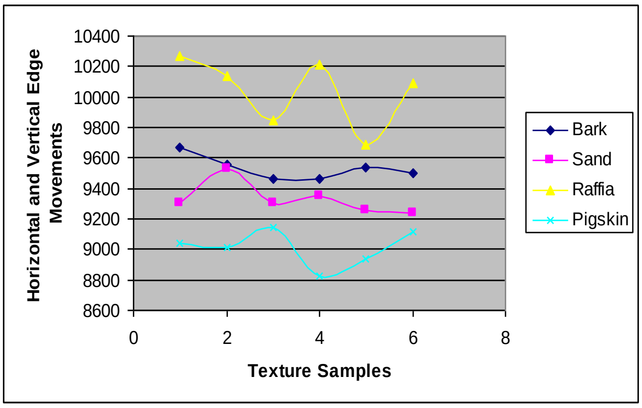

Fig -3: Classification graph using Horizontal and Vertical Edge Movements

Table -2: Right and Left Diagonal Edge direction movements are calculated after Edge sharpening for the Texture Group TG1

Sample No.	Bark	Sand	Raffia	Pigskin
1	11071	11434	10464	11695
2	11184	11205	10596	11721
3	11275	11435	10885	11590
4	11277	11387	10525	11910
5	11200	11478	11047	11801
6	11238	11496	10642	11616

The proposed method is also evaluated on another texture group the group 2(TG2) consists of Straw, Bsand, Wgrain and Grass. The frequency occurrences of the Horizontal and Vertical Edge direction movement of texture group 2 is listed out in table 3 and the classification graph is shown in figure 5. The frequency occurrences of the Right and Left Diagonal Edge direction movements of texture group 2 is listed out in table 4 and the classification graph is shown in figure 6. After sharpening the edges, the edge directional movements are identified again. The frequency occurrence of edge direction movement in Horizontal and Vertical direction of two texture groups are listed out in table 5 and corresponding graph is shown in figure 7. Left and Right diagonal direction movements of two texture groups are listed out in table 6 and corresponding graph is shown in figure

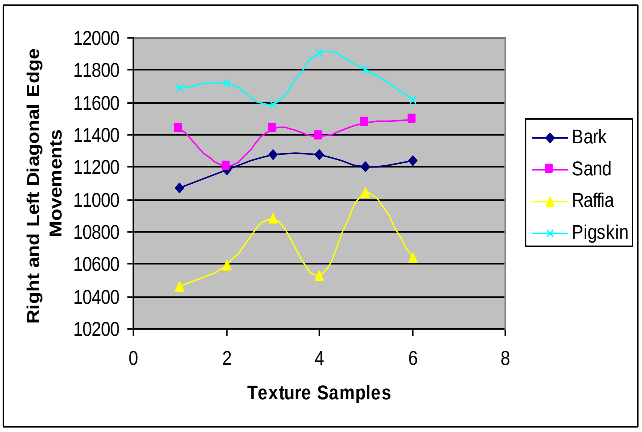

Fig -4: Classification graph using Right and Left Diagonal Edge Movements

Table -3: Horizontal and Vertical Edge direction movements are calculated after Edge sharpening for the Texture Group TG2

Sample No.	Straw	Bsand	Wgrain	grass
1	8238	8868	10811	10210
2	8694	9076	10812	10096
3	7300	8790	10844	10038
4	9185	8790	10779	9775
5	6350	8856	10518	10153
6	8726	8813	10751	9844

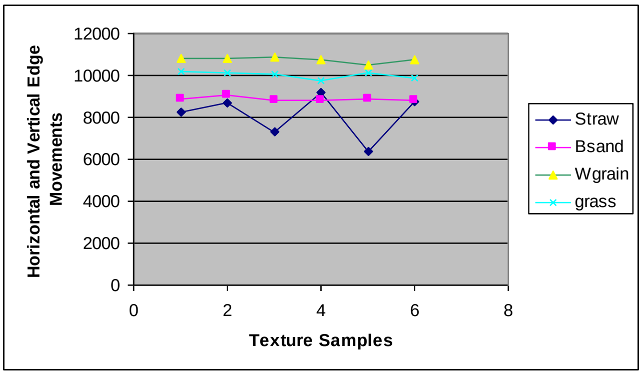

Fig -5: Classification graph using Horizontal and Vertical Edge Movements

Table -4: Right and Left diagonal Edge Direction movements are calculated after Edge sharpening for the Texture Group TG2

Sample No.	Straw	B sand	W Grain	Grass
1	12498	11868	9925	10526
2	12042	11660	9924	10640
3	13436	11946	9892	10698
4	11551	11946	9957	10961
5	14386	11880	10218	10583
6	12010	11923	9985	10892

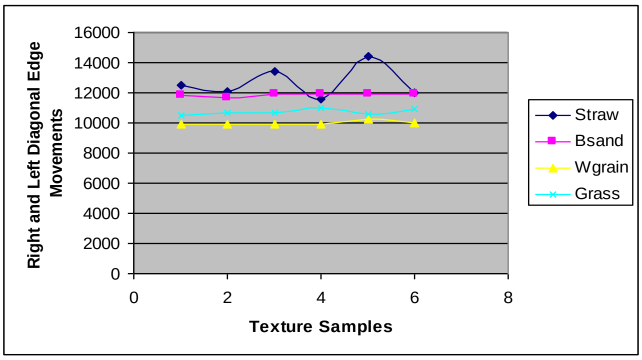

Fig -6: Classification graph using Right and Left Diagonal Edge Movements

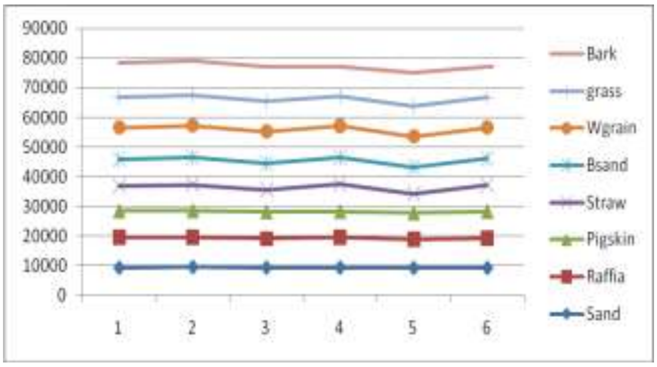

Fig -7: Classification graph using Horizontal and Vertical Edge Movements for Table 5

Table -5: Horizontal and Vertical Edge Direction movements are calculated after Edge sharpening for the Similar Textures

Sample No.	Sand	Raffia	Pigskin	Straw	Bsand	Wgrain	grass	Bark
1	9302	10272	9041	8238	8868	10811	10210	11864
2	9531	10140	9015	8694	9076	10812	10096	11782
3	9301	9851	9146	7300	8790	10844	10038	11724
4	9349	10211	8826	9185	8790	10779	9775	10388
5	9258	9689	8935	6350	8856	10518	10153	11389
6	9240	10094	9120	8726	8813	10751	9844	10539

Table -6: Right and Left diagonal Edge Direction movements are calculated after Edge sharpening for the similar Textures

Sample No.	Sand	Raffia	Pigskin	Straw	Bsand	Wgrain	grass	Bark
1	11434	10464	11695	12498	11868	9925	10526	8872
2	11205	10596	11721	12042	11660	9924	10640	8954
3	11435	10885	11590	13436	11946	9892	10698	9012
4	11387	10525	11910	11551	11946	9957	10961	10348
5	11478	11047	11801	14386	11880	10218	10583	9347
6	11496	10642	11616	12010	11923	9985	10892	10197

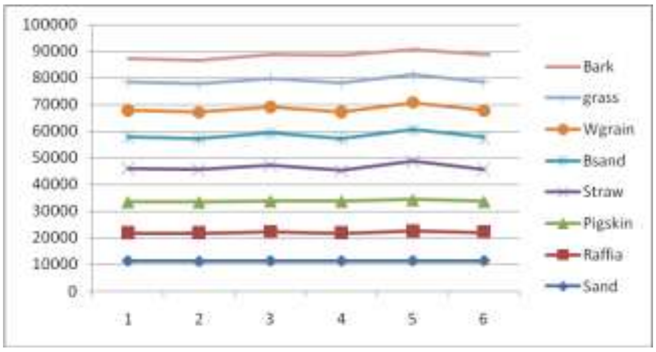

Fig -8: Classification graph using Right and Left Diagonal Edge Movements for Table 6

4. CONCLUSION

A clear discrimination between the textures of texture groups is visible in the graphs. To prove the further significance of the proposed method, nine similar textures from the texture groups TG1, TG2 and TG3 are taken as a case study. On these eight similar textures frequencies Horizontal and vertical and Right and Left diagonal edge direction movements are calculated and plotted in the graphs shown in Fig 7 and Fig. 8. From the graphs it is evident that horizontal and vertical movements on the opening of the image clearly discriminate the nine textures. The present study concludes that in the chosen nine similar textures, horizontal and vertical movements show a significant difference. The proposed right and left diagonal edge direction movements fail in discriminating these eight similar textures as shown in Fig. 8 However, the graphs in Fig. 5, 6, and indicate the usefulness of right and left diagonal edge direction movements which are discriminating, in some of the similar textures. By this, the present study concludes that 95% of the similar textures can be discriminated by horizontal and vertical edge movements after opening of the image.

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