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Stone Image Classification Based on Overlapped 5-bit T-Patterns Occurrence on 5-by-5 Sub Images

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ABSTRACT

Texture classification is widely used in understanding the visual patterns and has wide range of applications. The present paper derived a novel approach to classify the stone textures based on the patterns occurrence on each sub window. The present approach identifies overlapped nine 5 bit T-patterns (O5TP) on each 5×5 sub window stone image. Based the number of occurrence of T-patterns count the present paper classify the stone images into any of the four classes i.e. brick, granite, marble and mosaic stone images. The novelty of the present approach is that no standard classification algorithm is used for the classification of stone images. The proposed method is experimented on Mayang texture images, Brodatz textures, Paul Bourke color images, VisTex database, Google color stone texture images and also original photo images taken by digital camera. The outcome of the results indicates that the proposed approach percentage of grouping performance is higher to that of many existing approaches.

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1. INTRODUCTION

TEXTURE analysis and categorization are important for the interpretation and understanding of real-world visual patterns. Texture classification has a wide variety of prospective applications [1] such as regions classification in satellite images [2], defects detection in industrial surface inspection [3], and classification of pulmonary disease [4], diagnosis of leukemic cells in medical image [5] and breast cancer classification [6]. Texture analysis and classification is majorly achieved in one of the two ways, i.e. statistical approach and structural method. Statistical approach mainly concentrates on the stochastic things of the spatial distribution of gray levels in an image. Generally for finding the characteristics, co-occurrence matrix is frequent. From the co-occurrence matrix set of textural features extracted and these features are widely used to extract textural information from digital images [7],[8]. In structural approach, texture is considered as a repetition of some primitives. For texture classification and characterization, these methods have been applied by several authors and achieved success to a certain degree [9].

Characterization and classification of textures is an important step in the study of patterns on texture images. The textures are characterized and classified recently by various pattern approach methods: edge direction movements [10], long linear patterns [11],[12] and preprocessed images [13]. Marble texture description [14], avoiding Complex Patterns [15], Texture images are also described and classified by using various wavelet transforms techniques: one based on statistical parameters [16] and another one based on primitive patterns [17].

Sasi Kiran et.al [18] has proposed a method called Wavelet based Histogram on texton patterns (WHPT) and grouped the stone textures into four categories. The WHTP method got average % of grouping as 94.56. Dr. U Ravi Babu et.al [19] has proposed a method for stone textures classification into four groups. In this method also used patterns approach on grey-to-grey level preprocessed images. This method also achieved 97.15% as group classification, but this method is applied only for grouping stone textures into four groups. Suma Latha et.al. [20] has proposed a method called LBP-High-Symmetry (LBP-HS) for recognition of stone textures. This approach is also patterned approach for stone texture recognition. The LBP-HS method got 92% of recognition only. Sujatha B et al [21] proposed a method called Texton and Texture Orientation Co-occurrence Matrix (T&TO-CM) for the classification of textures. The proposed method achieved only 93% of classification rate.

In most approaches, which have been offered so far, researchers have tried to analyze and describe texture based on overlapped alphabet patterns for stone image classification. The proposed method put forward the pattern approach for grouping the stone textures into four classes. The high accuracy in texture classification in the results shows the quality of offered approach. The present paper proposes an approach for stone textures classification based on occurrences of overlapped T-patterns on each 5×5 sub-images.

The reminder of this paper is organized as follows: Section two describes to the identification of Overlapped 5-bit T-Patterns (O5TP) on the grey level image. Section three is related to deriving an algorithm for grouping the stone texture and analyses the results and finally, the conclusion included.

2. PROPOSED METHOD

2.1. Identification of Overlapped 5-bit T-Patterns on Each 5×5 sub-stone image

The proposed method O5TP consists of 4 steps. In step 1, convert the each stone texture color into the grey level image by using 7-bit binary code quantization method. Identify the 5-bit T-patterns in each 5×5 window of the stone texture image in step 2. In step 3, count the occurrences of T-patterns. Finally, based on the number of T-patterns derive a new algorithm for classification. The block diagram of the entire procedure is shown in Figure 1.

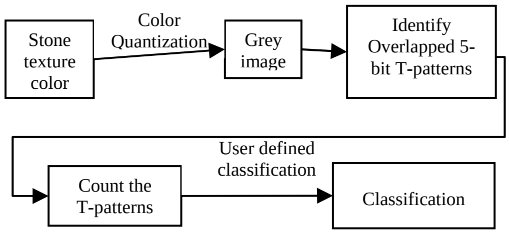

Figure 1. Block diagram of the proposed stone image classification

Step 1: Color to Grey Scale conversion

The Color image is nothing but a color channels. Most digital images are comprised of three separate color channels: a red channel, a green channel, and a blue channel. Grey scale means many shades (grey) from black to white. Generally, 7 ways are available to convert the color image into gray scale image i.e. averaging method, luma method, and De-saturation method, Custom #of gray shades method, horizontal error-diffusion dithering method, Single color channel and Single color channel method. In this paper utilized Custom # of gray shades method.

Custom # of gray shades method: this allows the user to specify how many shades of gray the resulting image will use. This value can be between 2 and 256 is accepted. If it is 2, the resultant image contains 2 shades i.e. black-and-white image, while 256 gives an image consists of 256 shades. The proposed method uses 8-bit color channels. So, maximum shades are only 256. In this paper uses 128 shades.

Any grayscale conversion algorithm is a three-step process:

1. Catch the green, red and blue values of a pixel
2. Convert those three values into a single gray value
3. Replace the three values with the new gray value

Elaborated algorithm for Grey Scale conversion

Step 1: Exchange threshold value = 255/(Number Of Shades-1)
Step 2: mean value = (Red + Green + Blue) / 3
Step 3: Gray = Integer (mean value / exchange threshold value) * exchange threshold value

Step 2: identification of 5-bit T-patterns each 5×5 grey-level stone sub image

The 5×5 sub image values are represented as P_1, P_2, … P_9, P_{10}, P_{11}, … P_{24}, P_{25}. The pixel position of the each 5×5 sub window was shown in Figure 2.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Figure 2. Pixel positions in 5×5 grey level facial sub image

In the proposed method consider the all possible T-pattern formed using 5-bits. The first T-pattern formed using 5 pixel P_1, P_2, P_3, P_7, and P_{12} and the second T-pattern formed using 5 pixel P_2, P_3, P_4, P_8, and P_{13} and so on. From first row 3 T-patterns are formed. From the Second row, another 3 T-patterns are formed. From the 3rd row another set of 3 patterns formed. Totally, nine overlapped 5-bit T-patterns are possible in each 5×5 sub window. Figure 3 shows the possible overlapped T-patterns on each 5×5 window.

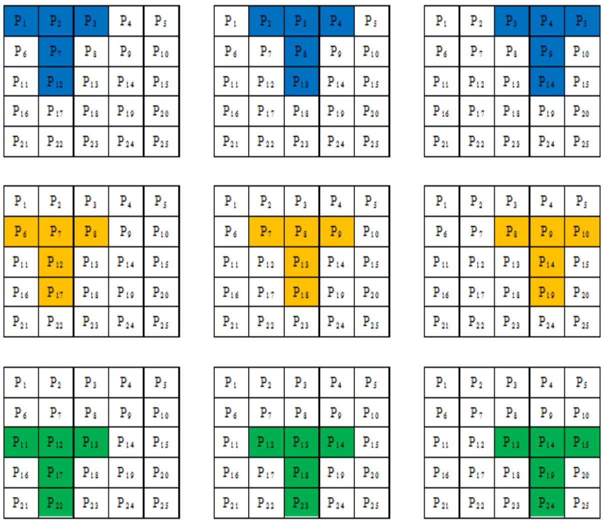

Figure 3. Overlapped 5-bit T-patterns on each 5×5 window

Step 3: Count the T-patterns

Count the frequency occurrence of the considered patterns in each 5×5 sub window on the stone texture adds these values to the feature vector.

Step 4: Classification of stone texture images

Based on frequency occurrences of overlapped 5-bit T-pattern in each 5×5 sub window on the stone texture image is classified as one of the four categories i.e. brick, Marble, Mosaic and Granite.

3. RESULTS AND DISCUSSION

To find the effectiveness of the proposed approach (O5TP) carried out the experiments on mixed stone textures Dataset which consists of various brick, granite, marble, and mosaic stone textures collected from Mayang, Google, CuRet VisTex, and Paul Bourke data-base and also from floor images taken by camera with the resolution of 256×256. The images used in this experiment is 1880 i.e. 480 images from Mayang database, 410 images from Paul Bourke database, 160 images from VisTex database, 130 images from CuRet database 300 images from Google database and 400 images from scanned photo graphs. Figure 4 shows the some of the stone textures used in this paper to evaluate the efficiency of the proposed approach. Some of the frequency of occurrence of overlapped 5-bit T-pattern (O5TP) of marble, mosaic, granite, and brick texture dataset images are listed-out in table 1 to 4 respectively. From Tables 1 to 5 designs a classification graph of five categories of stone images is shown in Figure 5.

Figure 4. some of the stone images used in this method with resolution of 256×256

Table 1. Overlapped 5-bit T-patterns occurrences of Brick textures

Image Name	*Pattern1*	*Pattern2*	*Pattern3*	*Pattern4*	*Pattern5*	*Pattern6*	*Pattern7*	*Pattern8*	*Pattern9*	*Total*
Brick.0001	129	84	78	126	140	96	124	99	125	1001
Brick.0002	122	138	136	122	133	129	137	135	128	1180
Brick.0003	132	125	126	129	135	129	139	134	132	1181
Brick.0004	133	147	131	136	155	128	137	141	124	1232
Brick.0005	139	139	135	135	151	139	136	145	142	1261
Brick.0006	140	140	142	139	147	138	143	151	139	1279
Brick.0007	146	157	134	150	153	149	162	158	155	1364
Brick.0008	170	175	156	168	168	158	168	168	158	1489
Brick.0009	165	174	153	178	179	151	166	181	166	1513
Brick.0010	168	171	158	168	172	161	176	181	164	1519
Brick.0011	162	169	163	176	166	181	176	170	176	1539
Brick.0012	212	220	185	199	205	180	196	224	199	1820
Brick.0013	192	205	185	203	218	199	210	221	201	1834
Brick.0014	232	249	245	202	218	217	201	218	216	1998
Brick.0015	221	222	219	235	238	214	233	239	216	2037
Brick.0016	251	256	239	259	277	253	279	299	267	2380
Brick.0017	295	288	302	286	289	303	264	275	286	2588
Brick.0018	429	433	416	424	431	402	418	421	406	3780
Brick.0019	447	452	453	440	444	439	425	434	429	3963
Brick.0020	616	631	438	584	412	468	608	613	618	4988

Table 2. Overlapped 5-bit T-patterns occurrences of Granite textures

Image Name	Pattern1	Pattern2	Pattern3	Pattern4	Pattern5	Pattern6	Pattern7	Pattern8	Pattern9	Total
blue_granite	2	3	1	2	1	5	4	0	0	18
blue_pearl	2	1	2	1	2	3	1	4	4	20
blue_topaz	0	4	0	0	0	4	3	0	4	15
brick_erosion	2	0	4	0	0	0	0	0	0	6
canyon_black	0	1	4	2	0	1	0	0	1	9
dapple_green	1	1	3	2	0	2	2	3	0	14
ebony_oxide	0	1	2	1	2	4	0	1	0	11
giallo_granite	1	4	0	0	0	0	2	0	1	8
gosford_stone	0	0	2	3	4	2	1	1	0	13
greenstone	0	1	4	0	2	3	2	0	0	12
interlude_haze	4	2	0	3	2	1	0	0	0	12
kalahari	0	4	2	2	1	1	3	1	1	15
mesa_twilight	4	1	1	0	1	2	3	2	0	14
mesa_verte	0	1	4	3	1	1	1	0	0	11
monza	4	0	0	3	2	1	0	1	0	11
pietro_nero	1	2	2	1	4	1	3	0	0	14
russet_granite	0	4	1	1	0	0	1	0	0	7
granite10	0	2	0	0	0	4	3	1	0	10
granite13	4	3	2	0	1	1	0	1	0	12
granite20	1	0	0	1	1	4	2	3	0	12

Table 3. Overlapped 5-bit T-patterns occurrences in Horizontal Direction of Marble textures

Image Name	Pattern1	Pattern2	Pattern3	Pattern4	Pattern5	Pattern6	Pattern7	Pattern8	Pattern9	Total
apollo	5	6	7	8	3	4	6	2	5	46
canyon_blue	9	9	8	7	9	16	8	8	9	83
cotto	9	9	18	5	1	10	16	27	9	104
curry_stratos	8	9	8	9	1	6	9	9	8	67
flinders_blue	10	11	15	9	7	8	16	9	8	93
flinders_green	9	10	16	9	10	9	7	8	9	87
forest_boa	10	11	10	16	10	8	8	10	8	91
forest_stone	10	10	10	10	11	9	11	16	10	97
goldmarble1	10	10	16	11	11	9	11	9	7	94
green_granite	9	13	10	10	10	10	12	16	9	99
grey_stone	12	10	10	13	10	10	16	10	14	105
greymarble1	9	10	12	11	10	10	10	11	9	92
greymarble3	9	13	10	12	11	10	10	11	10	96
marble001	11	12	11	11	12	10	16	10	10	103
marble018	12	13	11	11	12	10	10	9	10	98
marble034	11	15	13	18	9	16	11	13	17	123
marble033	16	13	11	14	10	14	9	16	10	113
marble012	10	14	11	10	33	30	15	15	12	150
marble014	11	12	16	11	15	12	12	14	11	114
marble020	15	15	13	15	13	12	10	12	11	116

Table 4. Overlapped 5-bit T-patterns occurrences in Horizental Direction of Mosaic textures

Image Name	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5	Pattern 6	Pattern 7	Pattern 8	Pattern 9	Total
concrete_bricks_170756	52	55	52	157	56	107	75	56	56	666
concrete_bricks_170757	58	56	52	155	57	106	73	56	55	668
concrete_bricks_170776	55	58	53	154	58	106	76	54	56	670
crazy_paving_5091370	54	57	56	154	60	105	77	58	54	675
crazy_paving_5091376	58	56	54	145	54	106	77	57	55	662
crazy_tiles_130356	15	58	57	146	59	103	80	61	54	633
crazy_tiles_5091369	64	58	16	162	55	16	82	55	53	561
dirty_floor_tiles_footprints_2564	95	62	59	156	59	106	79	61	60	737
dirty_tiles_200137	56	59	60	160	62	111	82	65	57	712
floor_tiles_030849	46	71	68	161	68	115	78	70	65	742
grubby_tiles_2565	58	66	65	165	67	112	88	76	72	769
kitchen_tiles_4270064	67	75	69	167	68	116	87	71	69	789
moroccan_tiles_030826	71	74	79	165	63	121	83	65	70	791
moroccan_tiles_030857	64	79	63	167	81	127	86	67	65	799
mosaic_tiles_8071010	71	70	72	173	68	122	91	72	71	810
mosaic_tiles_leaf_pattern_201005060	66	76	74	165	76	123	90	74	75	819
mosaic_tiles_roman_pattern_201005034	70	76	69	175	77	119	94	79	75	834
motif_tiles_6110065	74	73	74	173	81	127	92	74	67	835
ornate_tiles_030845	69	78	68	170	73	124	97	85	78	842
repeating_tiles_130359	80	74	64	184	81	115	107	91	63	859

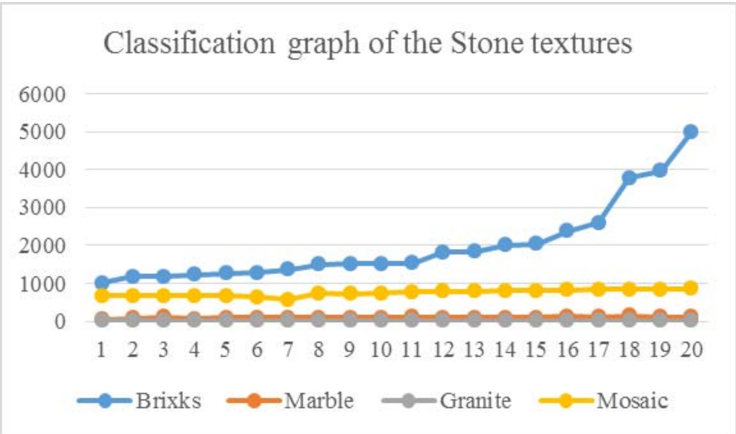

Figure 5. The proposed method generated classification graph

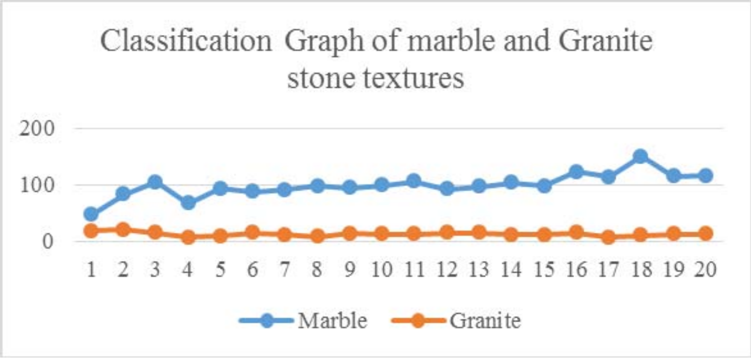

Figure 6. Generated Classification Graph of marble and Granite stone textures

The generated graph shown in figure 5 doesn't clearly indicate the granite and marble because of the occurrences of 5-bit T-patterns are less compare to other two groups. So, separate graph is generated for the occurrences of 5-bit T-patterns in marble and granite stone image. The generated classification graph for marble and granite is shown in figure 6. From the tables 1 to 4 and the classification graphs of Figure 5and 6 assign an exact and specific classification of color stone images using rate of recurrences of overlapped 5-bit T-patterns. A new algorithm is derived for classification among these four classes i.e. Granite, Marble, Mosaic, and Brick group of stone textures based on the above table values and generated graph. The rate of occurrences of 5-bit T-patterns is dependent on the dimension of the texture that means when dimensions of the image changed; the rate of occurrences is also changed. To avoid such problems the present paper derived a classification algorithm independent of the image size. This algorithm categorizes the stone textures in to four groups irrespective of their dimensions. The derived algorithm uses 256×256 dimension as a bench mark. If the rate of occurrences of the test image cataract within the range of minimum to maximum quantity of occurrences of two and four transitions of a fastidious stone then test image is categorized as a particular group.

Algorithm 1: Stone texture classification based on Overlapped 5-bit T-Patterns
Let Sum of occurrences of Overlapped 5-bit T-Patterns SOTP
START

if SOTP<= $\left(\frac{N \times N}{256 X 256} \times 20\right)$ then

Test image texture group is categorized as GRANITE class

Otherwise if SOTP <= $\left(\frac{N \times N}{256 X 256} \times 150\right)$ then
Test image texture group is categorized as MARBLE class

Otherwise if SOTP <= $\left(\frac{N \times N}{256 X 256} \times 900\right)$ then

Test image texture group is categorized as MOSAIC class

Otherwise if SOTP<= $\left(\frac{N \times N}{256 X 256} \times 5000\right)$ then

Test image texture group is categorized as BRICK class
Otherwise
Test image texture group is categorized as UNKNOWN class
STOP

4. COMPARISON BETWEEN PROPOSED METHOD AND OTHER EXISTING METHODS

The proposed method is compared with Wavelet based Histogram on Texton Patterns (WHTP) [18], which is used to classify the stone texture images into four categories by using wavelet based texton pattern histogram and texton feature evolution method [22], which is used to classify the images into four groups based on rate of occurrences of texton patterns. The proposed method is also compared with other existing method like Syntactic Pattern on 3D method [23] in which stone textures are classified into four categories based on the occurrence of systematic patterns. It is clearly obvious that, the proposed method show signs of a high classification rate than the existing methods. The percentage mean classification rate for the proposed method and other existing methods are represented in Table 5. The graphical representation of the percentage mean classification rate for the proposed method and other existing methods are shown in Figure 7. The Table 5 and Figure 7 shows the mean percentage classification of original images Google and scanned image. The mean percentage classification of proposed method and other existing methods of various databases are represented in Table 6 and graphical representation is shown in Figure 8.

Table 5. Mean percentage classification results of the proposed method and other existing methods

Image Dataset	Syntactic Pattern on 3D method	Wavelet based Histogram on Texton Patterns	Texton Feature Detection	Proposed Method
Original	93.29	93.15	95.56	96.85
Google	92.53	92.87	94.15	96.35
Scanned	93.3	93.82	95.27	96.29
Average	93.59	93.28	94.97	96.19

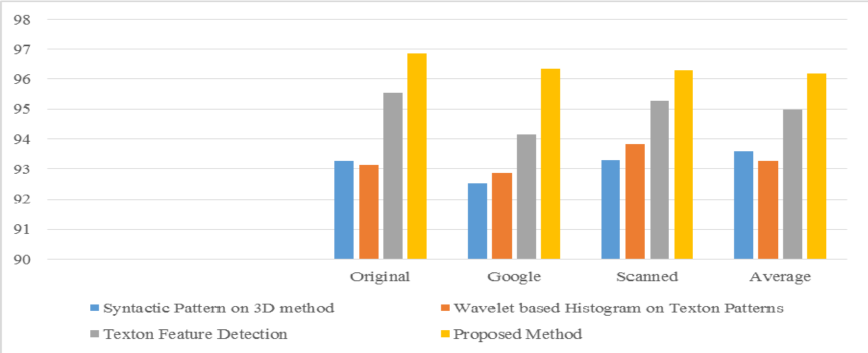

Figure 7. Classification chart of proposed method with other existing methods

Table 6. Mean percentage classification rates of the proposed method and other existing methods

Image Dataset	Syntactic Pattern on 3D method	Wavelet based Histogram on Texton Patterns	Texton Feature Detection	Proposed Method
VisTex	93.15	92.87	95.46	95.95
Texture Images Taken by Camera	92.87	91.7	95.12	96.35
CuReT	93.32	93.56	94.86	96.76
Mayang	92.83	92.95	94.39	95.85
Paul Bourke	93.05	93.05	95.23	95.93

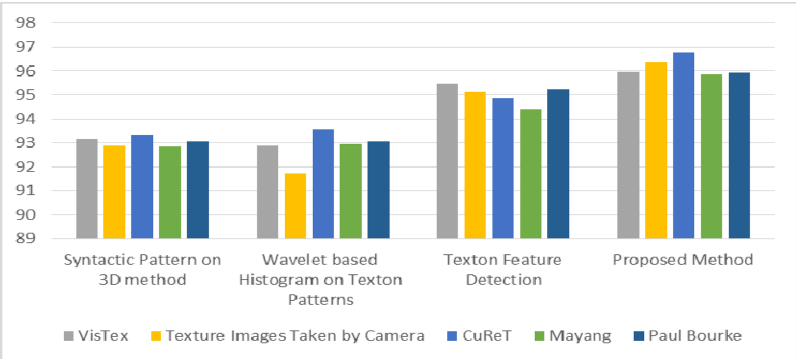

Figure 8. Mean percentage classification chart of the proposed method and other existing methods

No standard classification algorithm is used to test the data base. The novelty of the proposed method is that the proposed technique is applied on huge dataset. Even though it is applied on huge dataset it gives good results when compare with the other existing methods. Still, no such technique is available to apply on large dataset.

5. CONCLUSION

The present paper derived a new approach called Overlapped 5-bit T-Patterns (O5TP) for stone texture classification. The present paper considered Nine 5-bit T-patterns on each 5×5 sub image without losing the information about the image for texture analysis of the grey level image.The novelty of the proposed method is no standard classification algorithm is used for classification of stone textures. Proposed method is tested by using large set data base and got high % of group classification i.e. the strength of the proposed method. When compare with the other existing method gives more accurate and precise classification results. The O5TP is computationally inexpensive. The experimental results clearly indicate the efficacy of the proposed O5TP over the various existing methods.

REFERENCES

[1] C. H. Chen, *et al.*, "Handbook of Pattern Recognition and Computer Vision," 2nd ed. Singapore, World Scientific, 2000.

[2] R. M. Haralick, *et al*., "Textural features for image classification," *IEEE Trans. Syst., Man, Cybern*., vol/issue: 3(6), pp. 610–621, 1973.

[3] F. S. Cohen, *et al.*, "Automated inspection of textile fabrics using textural models," *IEEE Trans. Pattern Anal. Mach. Intell*., vol/issue: 13(8), pp. 803–808, 1991.

[4] R. N. Sutton and E. L. Hall, "Texture measures for automatics classification of pulmonary disease," *IEEE Trans. Comput*., vol/issue: C-21(7), pp. 667–676, 1972.

[5] H. Harms, *et al.*, "Combined local color and texture analysis of stained cells," *Comput. Vis. Graph., Image Process.*, vol/issue: 33(3), pp. 364–376, 1986.

[6] N. Hamdi, *et al*., "A new approach Based on Quantum Clustering and Wavelet Transform for breast cancer Classification: Comparative study," *International Journal of Electrical and Computer Engineering (IJECE)*, vol/issue: 5(5), pp. 1027-1034, 2015.

[7] T. Chang and C. C. J. Kuo, "Texture analysis and classification with tree-structured wavelet transform," *IEEE Trans. Image Processing*, vol/issue: 2(4), pp. 429-442, 1993.

[8] J. L. Chen and Kundu, "Unsupervised texture segmentation using multi-channel decomposition and hidden Markov models," *IEEE Trans. Image. Processing*, vol/issue: 4(5), pp. 603-620, 1995.

[9] R. W. Conners, "Toward a set of statistical features which measure visually perceivable qualities of texture," in *Proc. Pattern Recognition Image Processing Conf.*, pp. 382-390, 1979.

[10] B. E. Reddy, *et al.*, "Texture Classification by simple patterns on edge direction movements," *IJCSNS*, vol/issue: 7(11), pp. 220-225, 2007.

[11] V. V. Krishna, *et al.*, "Classification of textures based on distance function of linear patterns using mathematical morphology," *Proceedings of ICEM, conducted by JNT University, India*, 2005.

[12] V. V. Kumar, *et al.*, "An Innovative Technique of Texture Classification and Comparison Based on Long Linear Patterns," *Journal of Computer Science*, vol/issue: 3(8), pp. 633-638, 2007.

[13] V. V. Kumar, *et al.*, "A measure of patterns trends on various types of preprocessed images," *IJCSNS*, vol/issue: 7(8), pp. 253-257, 2007.

[14] A. Suresh, *et al.*, "An Innovative Technique of Marble Texture Description Based on Grain Components," *International Journal of Computer Science and Network Security*, vol/issue: 8(2), pp. 122-126, 2008.

[15] V. V. Kumar, *et al*., "Classification of Textures by Avoiding Complex Patterns, Science publications," *Journal of Computer Science*, 2008.

[16] U. S. N. Raju, *et al.*, "Texture Description using Different Wavelet Transforms Based on Statistical Parameters," *proceedings of the 2nd WSEAS International Symposium on WAVELETS THEORY & APPLICATIONS in Applied Mathematics, Signal Processing & Modern Science (WAV '08), Istanbul, Turkey*, pp. 174-178, 2008.

[17] V. V. Kumar, *et al.*, "A New Method of Texture Classification using various Wavelet Transforms based on Primitive Patterns," *ICGST International Journal on Graphics, Vision and Image Processing, GVIP*, vol/issue: 8(2), pp. 21-27, 2008.

[18] J. S. Kiran, *et al.*, "Wavelet based Histogram method for classification of textures," *IJECT*, vol/issue: 4(3), pp. 149-164, 2013.

[19] U. R. Babu , *et al*., "Texture Classification based on Texton Patterns using on various Grey to Grey level Preprocessing Methods," *International Journal of Signal Processing, Image Processing and Pattern Recognition*, vol/issue: 6(4), 2013.

[20] L. Sumalatha and B. Sujatha, "A New Approach for Recognition of Mosaic Textures by LBP Based On RGB Model," *Signal & Image Processing: An International Journal (SIPIJ)*, vol/issue: 4(1), 2013.

[21] B. Sujatha, *et al*., "Texture Classification Using Texton Co-Occurrence Matrix Derived From Texture Orientation," *International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307*, vol/issue: 2(6), 2013.

[22] U. R. Babu, *et al.*, “Texture Classification Based on Texton Features,” *I.J. Image, Graphics and Signal Processing*, vol/issue: 4(8), pp. 36-42.
[23] Suresh A. and V. V. Kumar, “Pattern Based Classification of Stone Textures on a Cubical Mask,” *International Journal of Universal Computer Sciences*, vol/issue” 1(1), pp. 4-9, 2010.

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