Chapter-6

TEXTURE CLASSIFICATION BASED ON INTEGRATED METHOD

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6.1 BRIEF OUTLINE OF THE CHAPTER

The present chapter proposes a novel way of extracting local texture features based on the primitive shapes on texton based Local Directional Pattern (LDP). To reduce the dimensionality the proposed research Integrated Local Directional Pattern with OR operation on Textons (ILDP-T). Edge plays a crucial role in analyzing many image processing and pattern recognition problems. To have a precise classification based on edges it is always important to find edges in all eight directions in a 3x3 neighborhood. Edge responses are more crucial and significant on LBP based methods because edges can overcome the problems involved with noise and illumination. For this LDP is used in the present thesis. The proposed shape primitives (SP) on ILDP-T (SP - ILDP-T) are rotationally invariant due to Kirsch Edge Response.

6.2 THE PROPOSED SHAPE PRIMITIVES ON ILDP-T (SP-ILDP-T) FOR CLASSIFICATION

The pattern analysis of an image plays an important and crucial role in classification and characterization of textures. That's why the present thesis investigates how the frequency occurrences of various texture primitive shapes on textons vary on stone textures. So far, no study has

attempted to classify the stone textures based on the frequency occurrences of SP-ILDP-T. The proposed method consists of three steps.

The block diagram of the proposed method is shown in Fig.6.1.

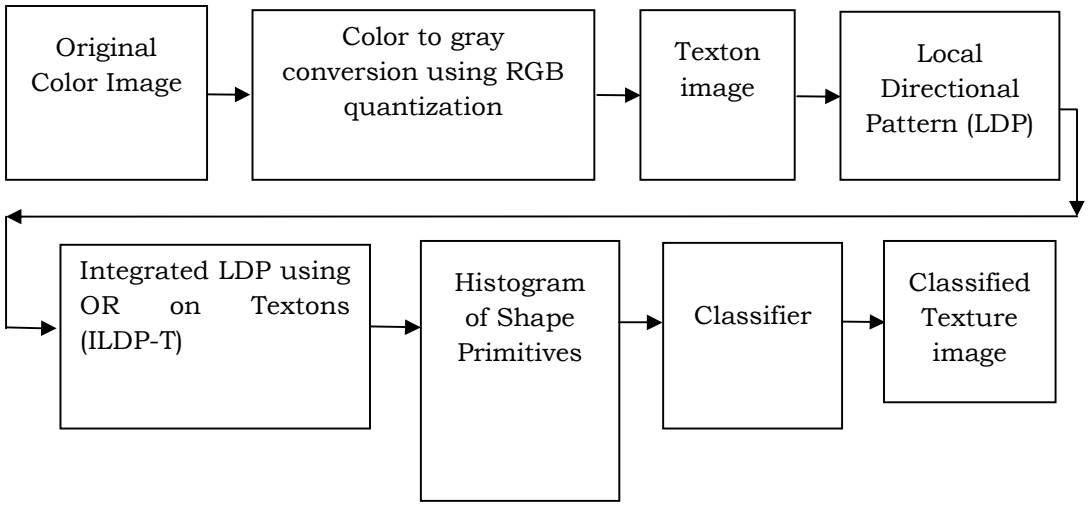


Fig.6.1: Integrated framework for texture classification using SP - ILDP-T**.**

6.2.1 Color Quantization and Texton Evaluation

To convert color images into gray level image, the proposed SP-ILDP-T approach utilized RGB color quantization method. In order to extract color information, the RGB color space which quantizes the color space into 8-bins is used. Then the statistical information of textons is calculated to describe image features as described in the second chapter.

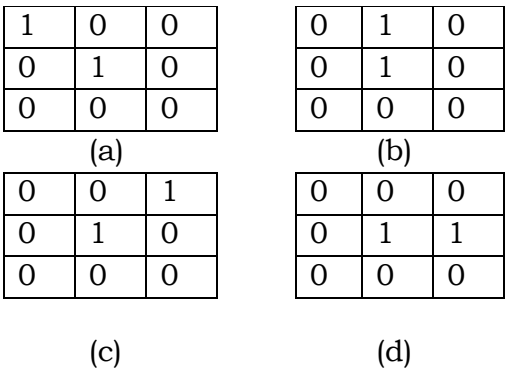
6.2.2 Derivation Local Directional Pattern (LDP) with Kirsch Edge Response

The present thesis evaluates LDP using eight directional edge response value of a particular pixel using Kirsch masks in eight different

orientations (M_0~M_7) centered on its own position [77]. By this more stable patterns are formed that can sustain to the effects of noise, illumination changes and various conversion schemes of color textures into gray textures.

6.2.3 Evaluation of Shape Primitives (SP) on ILDP-T (SP - ILDP-T)

On the Integrated LDP with OR operation on Textons (ILDP-T) of the previous step, the present study evaluated the frequency occurrence of shape primitives on a 3×3 mask. The novel classification approach of the present study is based on the number of shape primitives that occur in any order instead of calculating the frequency occurrences of various patterns on a 3×3 mask. These make the present method as rotational shape invariant. Frequency occurrences of shape primitives in the present thesis are counted if and only if the central pixel of the window contains an intensity value or 1. If the central pixel is not a 1 then the window is treated as a NoN- intensity component. There will be 8 combinations of SP with one pixel intensity other than central pixel. This is shown in the Fig.6.2.



0	0	0
0	1	0
0	0	1

(e)

0	0	0
0	1	0
0	1	0

(f)

0	0	0
0	1	0
1	0	0

(g)

0	0	0
1	1	0
0	0	0

(h)

Fig.6.2: Representation of SP-one pixel intensity.

6.3 RESULTS AND DISCUSSIONS

Experiments are carried out to demonstrate the classification efficacy of the proposed method on various brick, granite, and marble and mosaic stone textures with resolution of 256×256 collected from Vistex, Akarmarble, Ashishimpex, Brodtaz and Mayang albums. The four classes of stone textures are displayed in Fig.1.1 to Fig.1.3. Dataset contains 80 original color texture images. The sum of frequency of occurrence of all shape primitives on ILDP-T of marble, brick, granite and mosaic input texture image are listed out in Tables 6.1, 6.2, 6.3 and 6.4 respectively. The classification graph is shown in Fig.6.3.

Table 6.1: Frequency occurrences of SP on ILDP-T on marble Texture.

S.no	Texture Name	SP1	SP2	SP3	SP4	SP5	SP6	SP7	Total
1	Apollo	2	6	149	133	598	321	183	1392
2	Canyon_blue	3	7	137	127	613	325	159	1371
3	Cotto	1	3	88	82	354	282	155	965
4	Curry_stratos	1	1	97	139	729	361	174	1502
5	Flinders_blue	0	5	109	75	621	577	266	1653
6	Flinders_green	0	3	133	185	681	374	183	1559
7	Forest_boa	1	3	44	102	699	269	127	1245
8	Forest_stone	0	0	8	19	110	165	77	379
9	Goldmarble1	15	14	74	100	402	375	194	1174
10	Green_granite	0	0	4	3	27	44	15	93
11	Grey_stone	0	0	25	19	156	384	180	764
12	Greymarble1	2	0	69	37	356	450	289	1203
13	Greymarble3	1	4	644	168	445	98	26	1386
14	Marble01	0	0	55	54	304	486	207	1106
15	Marble18	0	0	4	3	27	42	12	88
16	Marble34	0	0	34	41	238	276	155	744
17	Marble33	3	3	207	86	457	504	245	1505
18	Marble12	0	0	4	13	96	236	83	432
19	Marble14	0	0	4	3	27	42	12	88
20	Marble20	0	0	4	4	30	58	15	111

Table 6.2: Frequency occurrences of SP on ILDP-T on brick textures.

Sno	Texture Name	SP1	SP2	SP3	SP4	SP5	SP6	SP7	Total
1	Brick.0001	1	18	246	292	1258	975	429	3219
2	Brick.0002	6	17	285	298	962	1061	563	3192
3	Brick.0003	1	15	322	382	1240	972	421	3353
4	Brick.0004	4	13	288	361	1431	913	383	3393
5	Brick.0005	6	32	372	427	1265	992	352	3446
6	Brick.0006	2	37	326	495	1543	1194	369	3966
7	Brick.0007	9	61	383	461	1412	1217	348	3891
8	Brick.0008	23	63	415	395	1704	868	321	3789
9	Brick.0009	16	55	358	401	1364	1228	461	3883
10	Brick.0010	41	69	431	469	1168	1052	370	3600
11	Brick.0011	30	61	468	474	1319	900	315	3567
12	Brick.0012	6	32	371	400	1500	858	350	3517
13	Brick.0013	24	63	434	457	1397	1149	364	3888
14	Brick.0014	0	5	219	249	955	1034	694	3156
15	Brick.0015	41	83	403	428	1273	1049	409	3686
16	Brick.0016	16	45	422	509	1540	1184	351	4067
17	Brick.0017	9	26	522	367	924	881	403	3132
18	Brick.0018	16	43	528	432	963	979	448	3409
19	Brick.0019	11	28	526	366	999	902	410	3242
20	Brick.0020	7	25	411	353	845	1107	546	3294

Table 6.3: Frequency occurrences of SP on ILDP-T on granite Texture.

S.no	Texture Name	SP1	SP2	SP3	SP4	SP5	SP6	SP7	Total
1	Blue_granite	2	4	130	150	849	431	195	1761
2	Blue_pearl	2	18	139	147	994	651	271	2222
3	Blue_topaz	6	32	308	241	737	552	292	2168
4	Brick_erosion	1	4	86	119	616	714	422	1962
5	Canyon_black	0	8	141	131	724	730	283	2017
6	Dapple_green	11	32	198	255	621	794	336	2247
7	Ebony_oxide	3	1	225	94	622	741	404	2090
8	Giallo_granite	8	21	274	102	625	529	331	1890
9	Gosford_stone	1	3	182	67	627	707	402	1989
10	Greenstone	7	7	230	79	599	661	348	1931
11	Interlude_haze	4	10	741	301	685	214	62	2017
12	Kalahari	6	17	656	153	575	239	120	1766
13	Mesa_twilight	6	10	752	284	702	215	51	2020
14	Mesa_verte	1	2	682	248	724	412	185	2254
15	Monza	0	1	126	76	507	773	416	1899
16	Pietro_nero	0	4	194	72	536	657	336	1799
17	Russet_granite	2	4	268	189	718	741	338	2260
18	Granite10	10	30	443	262	680	559	263	2247
19	Granite13	17	32	313	247	649	570	179	2007
20	Granite20	0	3	291	118	480	534	240	1666

Table 6.4: Frequency occurrences of SP on ILDP-T on mosaic Texture.

S. No.	Texture Name	SP1	SP2	SP3	SP4	SP5	SP6	SP7	Total
1	Concrete_bricks_170756	3	10	125	175	1018	860	373	2564
2	Concrete_bricks_170757	0	8	202	140	1344	741	278	2713
3	Concrete_bricks_170776	3	9	180	141	966	755	393	2447
4	Cragy_paving_5091370	2	15	337	301	1287	695	336	2973
5	Cragy_paving_5091376	0	9	160	340	1130	885	349	2873
6	Crazy_tiles_130356	0	2	39	103	540	985	811	2480
7	Crazy_title_5091369	5	25	151	306	884	1143	537	3051
8	Dirty_floor_tiles_foot_256	6	11	180	258	1183	770	263	2671
9	Dirty_tiles_200137	0	2	521	225	916	631	324	2619
10	Floor_tiles_030849	0	1	336	177	769	827	348	2458
11	Grubby_tiles_2565	0	8	584	275	888	497	239	2491
12	Kitchen_tiles_4270064	0	5	715	319	775	344	125	2283
13	Moroccan_tiles_030826	1	2	677	387	1060	581	182	2890
14	Moroccan_tiles_030857	0	1	261	178	911	1148	556	3055
15	Mosaic_tiles_8071010	0	3	626	342	923	479	181	2554
16	Mosaic_tiles_leaf201005	0	4	653	310	936	568	253	2724
17	Mosaic_tiles_leaf20100	2	25	334	259	1143	922	421	3106
18	Motif_tiles_6110065	0	3	626	342	923	479	181	2554
19	Ornate_tiles_030845	7	26	658	277	809	467	190	2434
20	Repeating_tiles_130359	4	11	279	229	718	815	393	2449

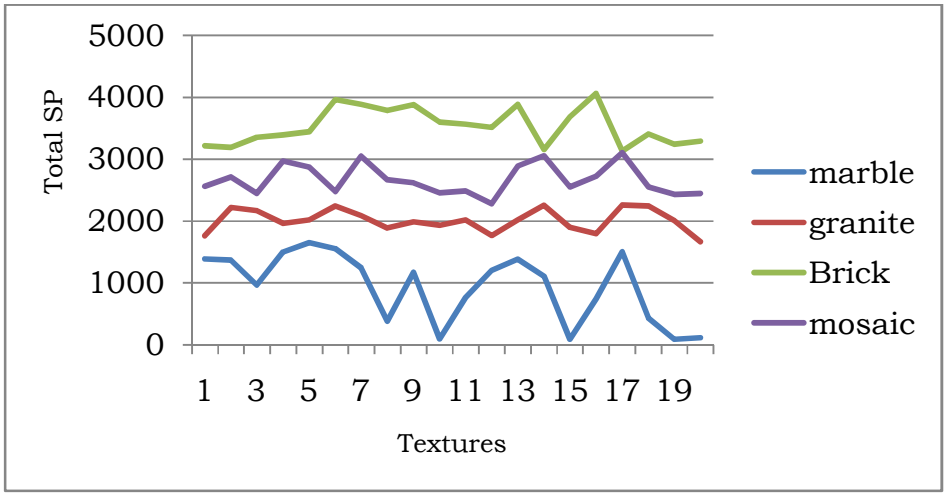


Fig.6.3: Classification graph of the stone textures based on SP on ILDP-T.

The Tables 6.1 to 6.4 and the classification graphs of Fig.6.3 indicate a precise and accurate classification on stone textures using frequency occurrences of SP on ILDP-T. Based on the above Tables and graph the present chapter derived a novel algorithm for classification and recognition among these four i.e. Brick, Granite, Marble and Mosaic group of textures. The frequency occurrences of SP on ILDP-T are dependent on the dimension of the textures. To address this problem the present research derived a classification algorithm which is a ratio dependent with the original dimension of the textures considered i.e. 256×256 with the dimension of the test image K×K.

Algorithm 6.1: Recognition of Stone textures based on frequency occurrences of SP on ILDP-T.

Let TSP is the total frequency of occurrences of Shape Primitives on ILDP-T test image with dimension K×K.

Begin

if (TSP <= $(\frac{K \times K}{256X256} \times 1653)$)

print (“The given one is marble stone”)

else if (TSP <= $(\frac{K \times K}{256X256} \times 2260)$)

print (“The given one is granite stone”)

else if (TSP <= $(\frac{K \times K}{256X256} \times 3106)$)

print(“The given one is mosaic stone”)

else if (TSP <= $(\frac{K \times K}{256X256} \times 4067)$)

print (“The given one is brick stone”)

else

print(“ Unknown class “)

End

The proposed SP on ILDP-T method is compared with Syntactic Pattern on 3D method [74] Primitive Pattern Unit approach [75] and texton feature evolution method [64]. The above two methods [74, 75] classified stone textures into two groups only. This indicates that the existing methods [74, 75] failed in classifying all stone textures. The percentage of classification rates of the proposed method and other

existing methods [64,74,75] are listed in Table 6.5. The Table 6.5 clearly indicates that the proposed SP on ILDP-T method outperforms the other existing methods. Fig.6.4 shows the comparison chart of the proposed SP on ILDP-T method with the other existing methods of Table 6.5.

Table 6.5: Mean % classification rate of the proposed and existing methods.

Image Dataset	Syntactic Pattern on 3D method	Primitive Pattern Unit approach	Texton Feature Detection	Proposed TOFTBM method	Proposed SP on ILDP-T method
Mayang	90.23	90.09	91.29	93.27	96.15
VisTex	92.53	92.56	94.15	93.84	96.05
Akarmarble	93.29	92.19	95.56	94.37	97.12
Brodatz	93.59	92.16	94.97	91.79	95.85
Ashishimpex	93.29	92.19	95.27	92.96	97.85

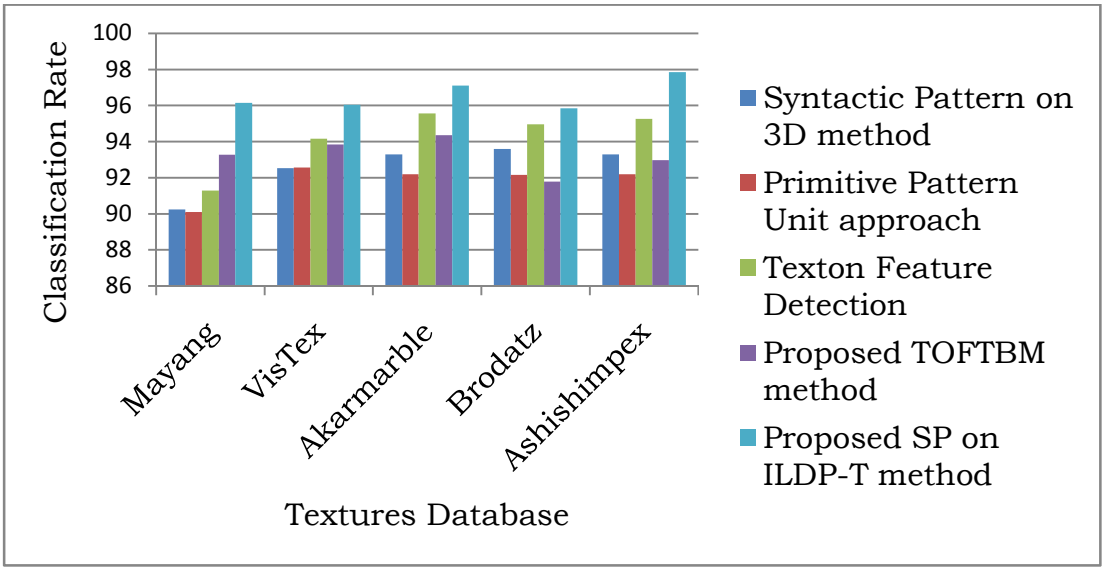


Fig.6.4: Comparison graph of proposed method and existing methods.

SUMMARY

The present study evaluated a new method of classification of stone textures based on frequency of occurrences of SP on ILDP-T method on a 3×3 mask. The proposed study attempted classification of four similar groups of stone textures namely brick, marble, granite and mosaic. Classification is carried out on finding the trends of SP of stone textures. The graphs plotted based on trends of Proposed SP on ILDP-T method clearly indicates that a precise and accurate classification of stone textures.