

CHAPTER 5

EXPERIMENTAL RESULTS

To demonstrate the effectiveness of the proposed method, we have applied it from the UCR (University of California, Riverside) Image Database that consists of 10,111 images of size 128×128 on 78 classes. The experiment system was performed on an Intel Core 2 Duo Processor T5600 PC with 1GB DRAM running Windows XP. The simulation program is implemented in MATLAB 7.

5.1 The typical experiment

For illustrating the computation, a typical example from Fig. 13 with symmetric-like composition is shown in this section. First, the images of *ROIs* with size 17×17 are extracted from Fig. 13(a) and are displayed in Fig. 13(b). Next, 10 features were computed from the full tested image and its 25 *ROIs*.

- (a) The averages of sharpness of each *ROI*. They are computed by Eq. (4) and plotted in Fig. 14.
- (b) The averages of brightness of each *ROI*. They are calculated by Eq. (5)
- (c) The four linearity of each *ROI*. The tested image is processed after the edge operation and its edge map is displayed in Fig. 15. The four linear features of horizontal, vertical, right-up to left-down diagonal, and left-up to right-down diagonal can be calculated from the edge map and these linear features of 25 *ROIs* are shown in Fig. 16, respectively.
- (d) The symmetry of *ROI* pairs. They are computed and displayed in Fig. 17. The color blocks of the Fig. 17 denote the corresponded *ROI* pair that is referenced in the recognition procedure.

(e) The three major directions of straight lines. The global features of the tested image are based on Hough transform and the directions of the straight lines can be extracted from the Hough space shown in Fig. 18. For straight lines longer than 20 pixels, the sums of thus lines are illustrated as a histogram by their directions in Fig. 19. The three measurements about major directions, horizontal, vertical, and uniform, of straight lines are estimated. The histogram shows the major straight lines are vertical in the tested image.

The true values of 6 estimated features are illustrated in Table 2, respectively. Next, the confidences of features are executed by regularizations for applying fuzzy logic rules and displayed in Table 3. The regularized features or confidences are assigned three fuzzy memberships by the associated membership functions of *High* (H), *Medium* (M), and *Low* (L), respectively. One of assigned fuzzy memberships, *High* (H), is shown in Table 4. Similar processing is executed for features *S*, *RV*, *RH*, and *RN*. Based on the recognizing rules, the tested image is evaluated into 8 possible compositions and their fuzzy relationships are assigned as Table 5. Therefore, we can think that the tested image is “medium” possibility in symmetric composition and “lower” in golden composition which the major palace locates at 1/3 of the photo width from left boundary.

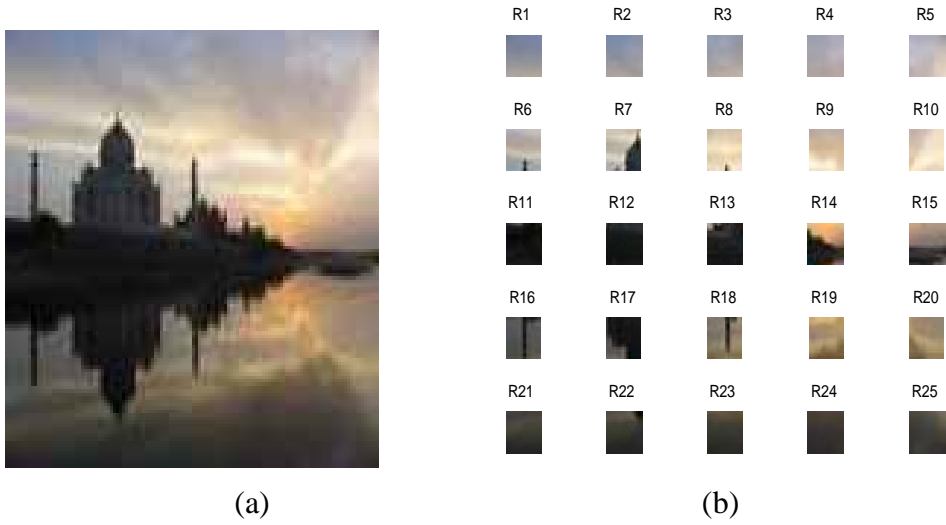


Fig. 13 (a) Test image. (b) The 25 ROI images with size 17×17 .

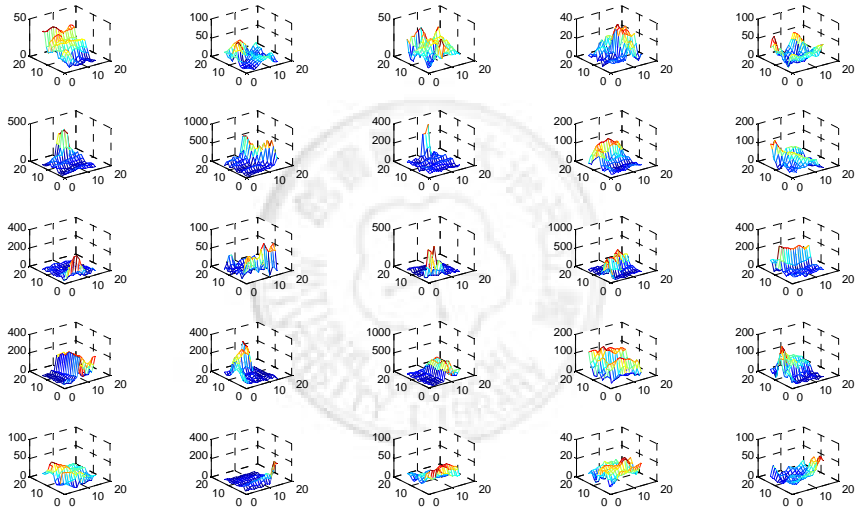


Fig. 14. The sharpness of 25 ROIs from the Fig. 13(b).

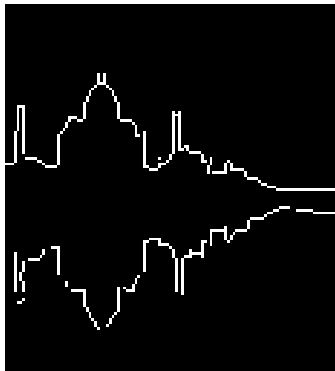


Fig. 15. The edge map of the tested image in Fig. 13(a).

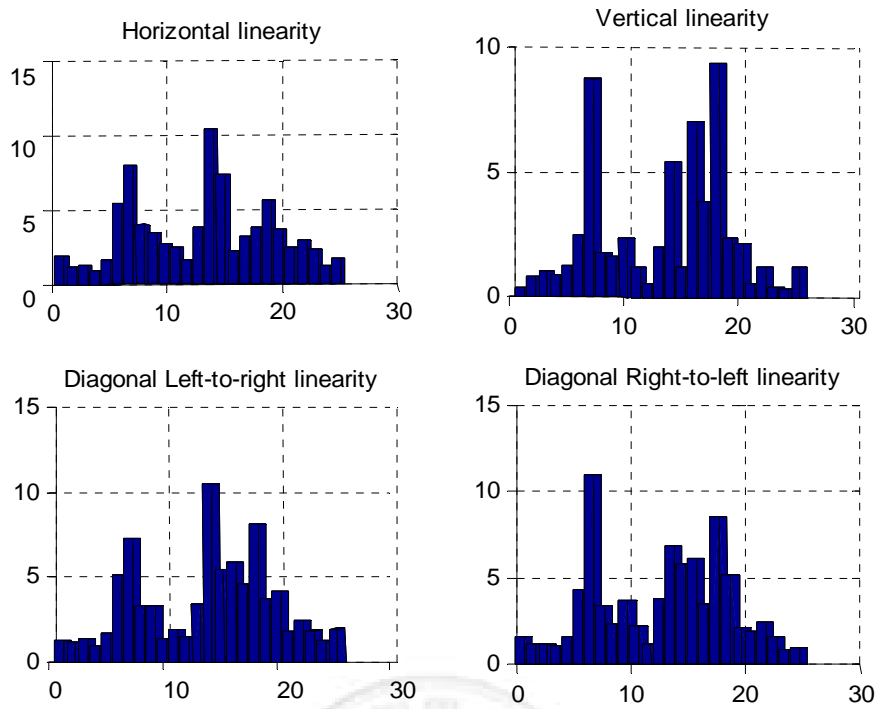


Fig. 16. The four features of linearity of the tested image. The abscissa of the plots denotes the number of the *ROI*.

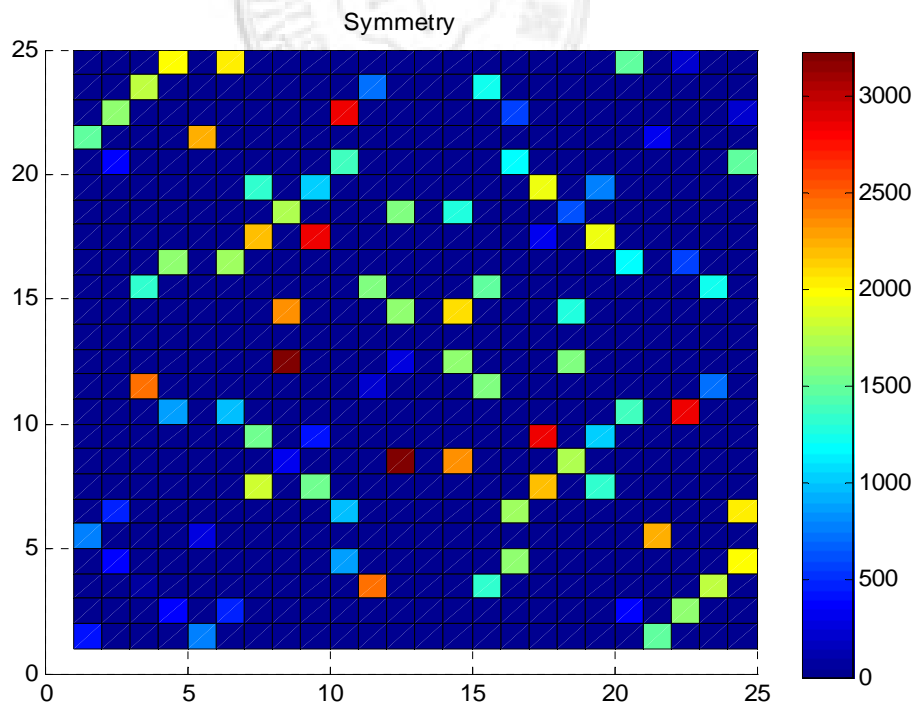


Fig. 17. The symmetric feature of all *ROI* pairs. The color blocks denote the corresponded *ROI* pair is referenced in the recognition procedure.

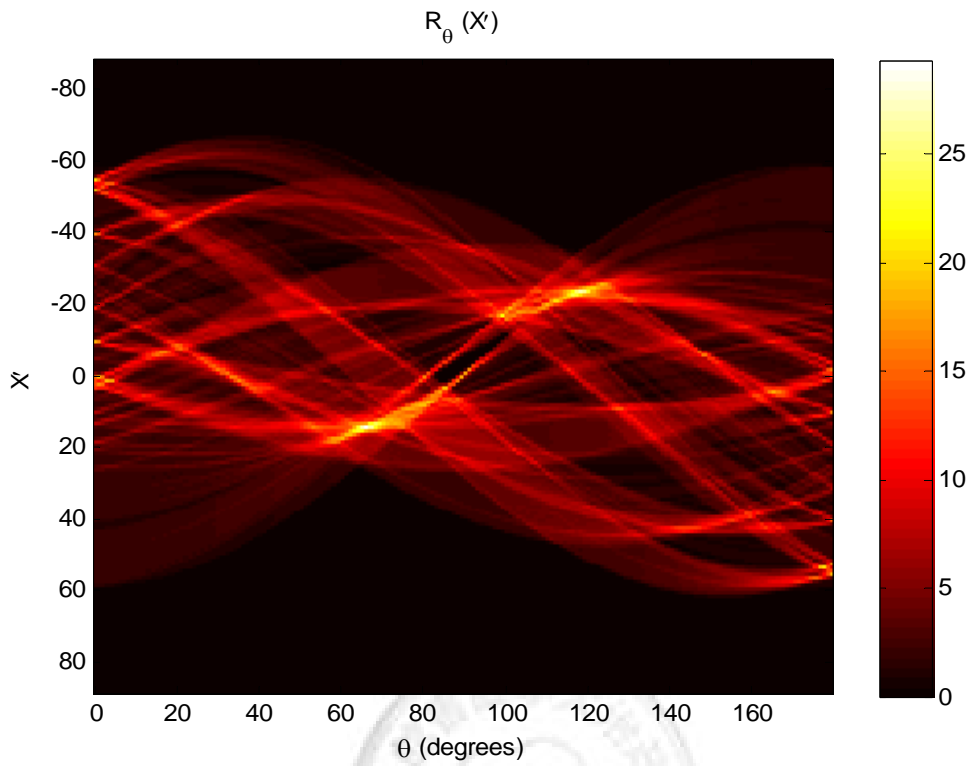


Fig. 18. The Hough space of the tested image

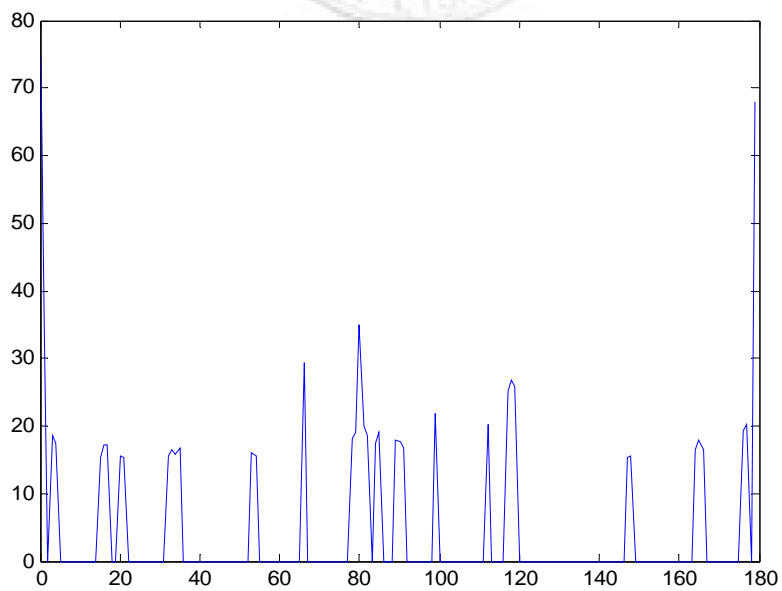


Fig. 19. The histogram of the directions of straight lines in the tested image.

Table 2

True average values of 6 estimated features in 25 ROIs.

ROI	<i>E</i>	<i>A</i>	<i>HL</i>	<i>VL</i>	<i>DLL</i>	<i>DRL</i>
1	1.98	143.30	1.89	0.41	1.30	1.56
2	1.61	150.30	1.19	0.80	1.10	1.15
3	1.84	162.90	1.28	1.04	1.35	1.18
4	2.87	169.50	0.95	0.88	0.89	1.05
5	2.39	188.40	1.67	1.29	1.69	1.64
6	6.60	170.50	5.41	2.54	5.16	4.32
7	13.34	151.50	8.02	8.75	7.24	10.93
8	4.71	214.50	4.03	1.81	3.33	3.39
9	4.08	200.00	3.46	1.67	3.29	2.38
10	3.86	219.10	2.75	2.35	1.40	3.67
11	2.94	18.94	2.44	1.23	1.91	2.19
12	1.86	25.74	1.66	0.57	1.44	1.23
13	4.88	35.51	3.85	2.04	3.38	3.78
14	12.67	96.30	10.48	5.46	10.54	6.89
15	7.62	100.60	7.35	1.22	5.43	5.78
16	8.19	74.83	2.25	7.06	5.83	6.12
17	5.73	36.83	3.24	3.85	4.59	3.53
18	11.48	115.00	3.76	9.39	8.13	8.59
19	6.44	140.80	5.63	2.38	3.75	5.19
20	4.57	137.80	3.68	2.16	4.14	2.08
21	2.55	56.37	2.43	0.53	1.75	1.94
22	3.44	53.87	2.91	1.24	2.48	2.43
23	2.39	57.24	2.31	0.44	1.85	1.62
24	1.35	53.28	1.24	0.37	1.30	0.86
25	2.22	65.54	1.70	1.21	1.96	0.96

Table 3

Confidences of 6 features in Table 2

ROI	E^*	A^*	HL^*	VL^*	DLL^*	DRL^*
1	0.13	0.56	0.18	0.03	0.07	0.08
2	0.10	0.59	0.11	0.07	0.06	0.06
3	0.12	0.64	0.12	0.09	0.07	0.06
4	0.19	0.66	0.08	0.08	0.04	0.05
5	0.16	0.74	0.16	0.12	0.09	0.09
6	0.54	0.67	0.68	0.25	0.31	0.25
7	1.00	0.59	1.00	1.00	0.48	0.86
8	0.35	0.84	0.45	0.17	0.19	0.19
9	0.29	0.78	0.37	0.16	0.18	0.13
10	0.27	0.86	0.28	0.23	0.07	0.21
11	0.20	0.07	0.24	0.11	0.10	0.12
12	0.12	0.10	0.16	0.05	0.07	0.06
13	0.37	0.14	0.43	0.20	0.19	0.22
14	1.00	0.38	1.00	0.69	0.82	0.45
15	0.66	0.39	1.00	0.11	0.33	0.36
16	0.74	0.29	0.22	1.00	0.36	0.39
17	0.45	0.14	0.34	0.43	0.27	0.20
18	1.00	0.45	0.41	1.00	0.56	0.61
19	0.53	0.55	0.72	0.24	0.21	0.32
20	0.34	0.54	0.40	0.21	0.24	0.11
21	0.17	0.22	0.24	0.05	0.09	0.10
22	0.24	0.21	0.30	0.11	0.13	0.13
23	0.16	0.22	0.23	0.04	0.10	0.08
24	0.08	0.21	0.11	0.03	0.07	0.04
25	0.14	0.26	0.16	0.11	0.10	0.05

Table 4The fuzzy “*High(H)*” memberships of confidences in Table 3

ROI	<i>E(H)</i>	<i>A(H)</i>	<i>HL(H)</i>	<i>VL(H)</i>	<i>DLL(H)</i>	<i>DRL(H)</i>
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.19	0.00	0.00	0.00	0.00
4	0.00	0.32	0.00	0.00	0.00	0.00
5	0.00	0.69	0.00	0.00	0.00	0.00
6	0.00	0.34	0.39	0.00	0.00	0.00
7	1.00	0.00	1.00	1.00	0.00	1.00
8	0.00	1.00	0.00	0.00	0.00	0.00
9	0.00	0.92	0.00	0.00	0.00	0.00
10	0.00	1.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00
14	1.00	0.00	1.00	0.43	1.00	0.00
15	0.32	0.00	1.00	0.00	0.00	0.00
16	0.69	0.00	0.00	1.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00
18	1.00	0.00	0.00	1.00	0.00	0.05
19	0.00	0.00	0.59	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00

Table 5

The memberships of 8 photographic compositions about the Fig. 6

Photographic composition	Fuzzy membership
Sun-like	0.00
Golden-like	0.27
Diagonal-like	0.00
Frame-like	0.00
Symmetry-like	0.50
Triangle-like	0.06
Vanishing- point-like	0.00
Horizontal/Vertical-line-like	0.00

5.2 The test sets

In this section, photographic experts sample 10 images for each photographic composition and a total of 80 images from the UCR Image Database. Tables 6.1-6.8 show the recognizing results. Because of the photographic composition of the image is usually mixed by different types, tested images may be recognized into two possible composition types.

Based on the purposed method, Table 7 illustrates the correlations between different photographic compositions and the outputs of fuzzy logic rules. For example, a photo with sun-like composition usually has the other characters of frame-like or/and triangle-like compositions that all are to emphasize the central object. The symmetric photo also has stronger tendency to the horizontal/Vertical-line-like composition. Both compositions exist on a long horizontal line and the long vertical lines generating by symmetric objects.

Table 6.1

Sample images with sun-like composition.

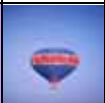



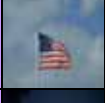
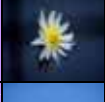
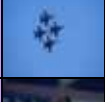



No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal/Vertical-line
sun1		0.68	0.00	0.00	0.00	0.65	0.00	0.00	0.00
sun2		0.65	0.00	0.00	0.00	0.58	0.00	0.00	0.38
sun3		0.63	0.00	0.00	0.05	0.00	0.37	0.00	0.00
sun4		0.49	0.24	0.00	0.00	0.21	0.00	0.00	0.00
sun5		0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sun6		0.67	0.00	0.00	0.67	0.00	0.55	0.00	0.00
sun7		0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sun8		0.49	0.00	0.42	0.23	0.00	0.36	0.30	0.00
sun9		0.88	0.00	0.00	0.00	0.18	0.00	0.00	0.00
sun10		0.66	0.00	0.00	0.00	0.42	0.26	0.00	0.00

Table 6.2

Sample images with golden-like composition.

No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal /Vertical -line
golden1		0.18	0.60	0.00	0.00	0.39	0.00	0.00	0.00
golden 2		0.04	0.84	0.00	0.00	0.16	0.58	0.00	0.00
golden 3		0.00	0.65	0.00	0.08	0.00	0.00	0.00	0.00
golden 4		0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00
golden 5		0.00	0.91	0.00	0.00	0.44	0.00	0.04	0.00
golden 6		0.00	0.79	0.00	0.00	0.27	0.00	0.20	0.00
golden 7		0.00	0.81	0.00	0.00	0.33	0.00	0.70	0.00
golden 8		0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00
golden 9		0.00	0.59	0.00	0.00	0.31	0.00	0.00	0.00
golden 10		0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.3

Sample images with diagonal-like composition.

No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal /Vertical -line
diagonal 1		0.00	0.00	1.00	0.00	0.09	0.00	0.00	0.00
diagonal 2		0.01	0.27	1.00	0.00	0.10	0.07	1.00	0.00
diagonal 3		0.00	0.00	0.73	0.00	0.50	0.19	0.00	0.00
diagonal 4		0.00	0.62	1.00	0.00	0.08	0.00	0.00	0.00
diagonal 5		0.00	0.75	0.91	0.00	0.16	0.02	0.00	0.00
diagonal 6		0.17	0.51	1.00	0.00	0.37	0.00	0.00	0.00
diagonal 7		0.00	0.00	1.00	0.00	0.46	0.32	0.00	0.00
diagonal 8		0.20	0.06	1.00	0.00	0.29	0.00	0.00	0.00
diagonal 9		0.30	0.61	1.00	0.00	0.14	0.00	0.18	0.00
diagonal 10		0.15	0.29	1.00	0.00	0.00	0.00	0.00	0.00

Table 6.4

Sample images with frame-like composition.










No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal /Vertical -line
frame 1		1.00	0.69	0.00	1.00	0.00	1.00	0.00	0.00
frame 2		0.81	0.00	0.00	0.85	0.00	0.79	0.26	0.00
frame 3		0.64	0.00	0.00	1.00	0.00	0.55	0.00	0.00
frame 4		0.00	0.63	0.00	0.67	0.23	0.00	0.00	0.00
frame 5		0.53	0.00	0.00	1.00	0.50	0.29	0.00	0.00
frame 6		0.00	0.00	0.00	1.00	0.00	0.57	0.00	0.00
frame 7		0.80	0.00	0.00	1.00	0.40	0.74	0.00	0.00
frame 8		0.45	0.55	0.00	0.76	0.00	0.00	0.00	0.00
frame 9		0.97	0.00	0.00	1.00	0.00	0.00	0.00	0.00
frame 10		0.88	0.00	0.00	1.00	0.00	0.39	0.00	0.00

Table 6.5

Sample images with symmetry-like composition.

No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal /Vertical -line
symmetry 1		0.00	0.06	0.00	0.00	0.63	0.00	0.00	0.00
symmetry 2		0.00	0.00	0.51	0.00	0.61	0.00	0.00	0.21
symmetry 3		0.02	0.00	0.00	0.00	0.38	0.35	0.00	0.00
symmetry 4		0.00	0.00	0.55	0.00	0.84	0.42	0.00	0.00
symmetry 5		0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
symmetry 6		0.00	0.00	0.54	0.00	0.77	0.00	0.00	0.00
symmetry 7		0.00	0.27	0.00	0.00	0.50	0.06	0.00	0.00
symmetry 8		0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00
symmetry 9		0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00
symmetry 10		0.00	0.00	0.00	0.47	0.80	0.00	0.18	0.18

Table 6.6

Sample images with triangle-like composition.

No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal /Vertical -line
triangle 1		0.69	0.00	0.18	0.00	0.42	0.77	0.63	0.00
triangle 2		0.35	0.00	0.00	0.98	0.05	1.00	0.00	0.00
triangle 3		0.91	0.00	0.00	0.42	0.22	1.00	0.00	0.00
triangle 4		0.85	0.83	0.00	0.72	0.00	1.00	0.00	0.00
triangle 5		0.00	0.31	0.00	0.00	0.08	1.00	0.00	0.00
triangle 6		0.93	0.00	0.00	0.00	0.49	1.00	1.00	0.00
triangle 7		0.89	0.34	0.00	0.00	0.00	0.79	0.00	0.00
triangle 8		0.41	0.00	0.00	0.00	0.22	0.50	0.00	0.00
triangle 9		0.82	0.00	0.00	0.00	0.50	1.00	1.00	0.00
triangle 10		0.96	0.95	0.00	0.00	0.01	1.00	0.00	0.00

Table 6.7

Sample images with vanishing-point-like composition.











No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal/Vertical-line
VP 1		0.08	0.00	0.00	0.00	0.70	0.00	1.00	0.00
VP 2		0.02	0.65	0.00	0.00	0.31	0.00	1.00	0.00
VP 3		0.00	0.00	0.00	0.73	0.00	0.90	1.00	0.00
VP 4		0.17	0.83	0.00	0.00	0.02	0.00	1.00	0.00
VP 5		0.00	0.00	0.00	0.00	0.12	0.00	1.00	0.00
VP 6		0.00	0.37	0.00	0.00	0.30	0.09	1.00	0.00
VP 7		0.50	0.00	0.00	0.73	0.00	0.63	1.00	0.00
VP 8		0.84	0.31	0.00	0.00	0.06	0.00	1.00	0.00
VP 9		0.88	0.00	0.00	0.00	0.56	0.00	1.00	0.00
VP 10		0.87	0.00	0.00	0.00	0.50	0.03	1.00	0.00

Table 6.8

Sample images with Horizontal/Vertical-line-like composition.

No.	Image	Sun	Golden	Diagonal	Frame	Symmetry	Triangle	Vanishing-point	Horizontal/Vertical-line
HV 1		0.00	0.00	0.42	0.30	0.47	0.29	0.00	1.00
HV 2		0.00	0.41	0.44	0.00	0.35	0.31	0.00	1.00
HV 3		0.00	0.00	0.30	0.00	0.87	0.60	0.00	1.00
HV 4		0.00	0.52	0.00	0.00	0.42	0.00	0.00	1.00
HV 5		0.47	0.18	0.30	0.00	0.31	0.00	0.00	1.00
HV 6		0.00	0.00	0.15	0.00	0.40	0.05	0.00	1.00
HV 7		0.83	0.00	0.00	0.00	0.11	0.00	0.00	1.00
HV 8		0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.82
HV 9		0.29	0.00	0.00	0.00	0.02	0.31	0.00	1.00
HV 10		0.00	0.00	0.72	0.00	0.22	0.00	0.00	1.00

Table 7

The correlations between different photographic compositions and the outputs of fuzzy logic rules.

Rules Composition	Sun (R15)	Golden (R16)	Diagonal (R17)	Frame (R18)	Symmetric (R19)	Triangle (R20)	Vanishing Point (R21)	Horizon-Vertic. (R22)
Sun	0.63	0.02	0.04	0.09	0.20	0.15	0.03	0.04
Golden	0.02	0.72	0.00	0.01	0.19	0.06	0.09	0.00
Diagonal	0.08	0.31	0.96	0.00	0.22	0.06	0.12	0.00
Frame	0.61	0.19	0.00	0.93	0.11	0.43	0.03	0.00
Symmetric	0.00	0.03	0.16	0.05	0.57	0.08	0.02	0.04
Triangle	0.68	0.24	0.02	0.21	0.20	0.91	0.26	0.00
Van. Point	0.33	0.22	0.00	0.15	0.26	0.16	1.00	0.00
Hon.-Vertic	0.16	0.11	0.23	0.03	0.35	0.16	0.00	0.98

