

Report

(a) Robert's Operator



For pixel (r, c) , calculate r_1, r_2

$$r_1 = I(r+1, c+1) - I(r, c), r_2 = I(r+1, c) - I(r, c+1)$$

gradient magnitude: $\sqrt{r_1^2 + r_2^2}$

If gradient magnitude ≥ 12 , output $(r, c) = 0$, else 255.

(b) Prewitt's Edge Detector



For pixel (r, c) , calculate p_1, p_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	-1	-1
1	1	1

p_1

-1		1
-1		1
-1		1

p_2

gradient magnitude: $\sqrt{p_1^2 + p_2^2}$

If gradient magnitude ≥ 24 , output $(r, c) = 0$, else 255.

(c) Sobel's Edge Detector



For pixel (r, c) , calculate s_1, s_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	-2	-1
1	2	1

s_1

-1		1
-2		2
-1		1

s_2

gradient magnitude: $\sqrt{s_1^2 + s_2^2}$

If gradient magnitude ≥ 38 , output $(r, c) = 0$, else 255.

(d) Frei and Chen's Gradient Operator



For pixel (r, c) , calculate f_1, f_2 by the following mask, (r, c) corresponds to the center of the mask.

-1	$-\sqrt{2}$	-1
1	$\sqrt{2}$	1

f_1

-1		1
$-\sqrt{2}$		$\sqrt{2}$
-1		1

f_2

gradient magnitude: $\sqrt{f_1^2 + f_2^2}$

If gradient magnitude ≥ 30 , output $(r, c) = 0$, else 255.

(e) Kirsch's Compass Operator



For pixel (r, c) , calculate k_n by the following mask, (r, c) corresponds to the center of the mask.

<table><tr><td>-3</td><td>-3</td><td>5</td></tr><tr><td>-3</td><td></td><td>5</td></tr><tr><td>-3</td><td>-3</td><td>5</td></tr></table> k_0	-3	-3	5	-3		5	-3	-3	5	<table><tr><td>-3</td><td>5</td><td>5</td></tr><tr><td>-3</td><td></td><td>5</td></tr><tr><td>-3</td><td>-3</td><td>-3</td></tr></table> k_1	-3	5	5	-3		5	-3	-3	-3	<table><tr><td>5</td><td>5</td><td>5</td></tr><tr><td>-3</td><td></td><td>-3</td></tr><tr><td>-3</td><td>-3</td><td>-3</td></tr></table> k_2	5	5	5	-3		-3	-3	-3	-3	<table><tr><td>5</td><td>5</td><td>-3</td></tr><tr><td>5</td><td></td><td>-3</td></tr><tr><td>-3</td><td>-3</td><td>-3</td></tr></table> k_3	5	5	-3	5		-3	-3	-3	-3
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5	-3	-3																																					
5		-3																																					
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-3		5																																					
-3	5	5																																					

gradient magnitude: $\max_{n=0,\dots,7} k_n$

If gradient magnitude ≥ 135 , output $(r, c) = 0$, else 255.

(f) Robinson's Compass Operator



For pixel (r, c) , calculate r_n by the following mask, (r, c) corresponds to the center of the mask.

<table><tr><td>-1</td><td></td><td>1</td></tr><tr><td>-2</td><td></td><td>2</td></tr><tr><td>-1</td><td></td><td>1</td></tr></table> r_0	-1		1	-2		2	-1		1	<table><tr><td></td><td>1</td><td>2</td></tr><tr><td>-1</td><td></td><td>1</td></tr><tr><td>-2</td><td>-1</td><td></td></tr></table> r_1		1	2	-1		1	-2	-1		<table><tr><td>1</td><td>2</td><td>1</td></tr><tr><td></td><td></td><td></td></tr><tr><td>-1</td><td>-2</td><td>-1</td></tr></table> r_2	1	2	1				-1	-2	-1	<table><tr><td>2</td><td>1</td><td></td></tr><tr><td>1</td><td></td><td>-1</td></tr><tr><td></td><td>-1</td><td>-2</td></tr></table> r_3	2	1		1		-1		-1	-2
-1		1																																					
-2		2																																					
-1		1																																					
	1	2																																					
-1		1																																					
-2	-1																																						
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1		-1																																					
2		-2																																					
1		-1																																					
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-1		1																																					
	1	2																																					

gradient magnitude: $\max_{n,n=0,\dots,7} r_n$

If gradient magnitude ≥ 43 , output(r, c) = 0, else 255.

(g) Nevatia-Babu 5x5 Operator



For pixel (r, c), calculate N_n by the following mask, (r, c) corresponds to the center of the mask.

100	100	100	100	100
100	100	100	100	100
0	0	0	0	0
-100	-100	-100	-100	-100
-100	-100	-100	-100	-100

0°

100	100	100	100	100
100	100	100	78	-32
100	92	0	-92	-100
32	-78	-100	-100	-100
-100	-100	-100	-100	-100

30°

100	100	100	32	-100
100	100	92	-78	-100
100	100	0	-100	-100
100	78	-92	-100	-100
100	-32	-100	-100	-100

60°

-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100
-100	-100	0	100	100

-90°

-100	32	100	100	100
-100	-78	92	100	100
-100	-100	0	100	100
-100	-100	-92	78	100
-100	-100	-100	-32	100

-60°

100	100	100	100	100
-32	78	100	100	100
-100	-92	0	92	100
-100	-100	-100	-78	32
-100	-100	-100	-100	-100

-30°

gradient magnitude: $\max_{n,n=0,\dots,5} N_n$

If gradient magnitude ≥ 12500 , output(r, c) = 0, else 255.