

Sheet 5 : (edge detection) - Omar Rashad Salem

Task1 :

$$Gx(3,3) = (100 \times -1) + (0) + (110 \times 1) = 10 \text{ (no normalizing' } \div 2')$$

$$Gy(3,3) = (1 \times 107) + 0 + (-1 \times 111) = -4 \text{ (no normalizing)}$$

$$\|G\| = \sqrt{Gy^2 + Gx^2} = \sqrt{16 + 100} = 2\sqrt{29}$$

$$\theta_{(gradient)} = \arctan\left(\frac{Gy}{Gx}\right) = \arctan\left(\frac{-4}{10}\right) = -21.801 \text{ degree}$$

$$\text{edge orientation is perpendicular to gradient orientation } \theta_{(gradient)} = -21.801 + \frac{\pi}{2} = 20.23 \text{ degree}$$

Task2 :

main steps of edge detection :

1. apply any gaussian filter to *SMOOTH* and reduce noise

2. apply two sobel filter (vertical and horizontal and save them separate)

(step two is approx gradient of the image if combined also you can apply one laplacian filter instead but its more sensitive to noise)

4. make new two mats one is $\|Gradient(mag)\|$, another is grad. direction (angle mat) FOR EACH PIXEL

(the gradient direction is normal to the *supposed* edge so the tangent (perpendicular) is actual direction of the edge)

5. do *Non.max. Suppression* on gradent mag mat only along the gradient direction and save new mat

6. do *Double thresholding* (linking) on new mat

7. do *Hysterisess threshholding* to convert all weak pixles to stron ONLY IF there is any strong nieghbour.

Task3 :

A)

Gx and Gy:

$$Gx(A) = -1 + 2 + 8 + 5 = 6$$

$$Gx(B) = (-1 * 3) + (0 * 6) + (1 * 0) + (-2 * 4) + (0 * 2) + (2 * 5) + (-1 * 2) + (0 * 0) + (1 * 4) = 1$$

$$Gx(C) = (-1 * 6) + (0 * 0) + (1 * 3) + (-2 * 2) + (0 * 5) + (2 * 7) + (-1 * 0) + (0 * 4) + (1 * 4) = 11$$

$$Gy(A) = -1 + 2 + 8 + 5 = 14$$

$$Gy(B) = (-1 * 3) + (-2 * 6) + (-1 * 0) + (0 * 4) + (0 * 2) + (0 * 5) + (1 * 2) + (2 * 0) + (1 * 4) = -9$$

$$Gy(C) = (-1 * 6) + (-2 * 0) + (-1 * 3) + (0 * 2) + (0 * 5) + (0 * 7) + (1 * 0) + (2 * 4) + (1 * 4) = 3$$

Magnitude:

$$\|G_A\| = \sqrt{14^2 + 6^2} = 2\sqrt{58}$$

$$\|G_B\| = \sqrt{1^2 + (-9)^2} = \sqrt{82}$$

$$\|G_C\| = \sqrt{3^2 + 11^2} = \sqrt{130}$$

Orientation:

$$\theta_A = \arctan\left(\frac{14}{6}\right) = 66.8 \text{ degree}$$

$$\theta_B = \arctan\left(\frac{-9}{1}\right) = -83.66 \text{ degree}$$

$$\theta_C = \arctan\left(\frac{3}{11}\right) = 15.255 \text{ degree}$$

B) Graph:

 title

 title

 title

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