COMPARISON OF DIFFERENT TECHNIQUES FOR EDGE DETECTION: MORPHOLOGY, GRADIENT AND THEIR COMBINATION.

NAMITA SENGAR

Abstract: Edges are present in the image where there is a sudden change in the intensity or frequency. This feature is widely used in image processing system in different areas. This paper presents a comparison between two important techniques for edge detection by morphology and edge detection by using gradient method. Morphological operations are very fast and efficient.There is an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges. Both methods are compared by experimental results on various images.

Keywords: About four key words or phrases in alphabetical order, separated by commas.

Introduction: Edge detection is the process to identify the sharp edges and discontinuities in the images. Edges are mainly present in the image where there is a sudden change in a intensity or we can say that in a frequency. In this paper there is a comparison of two techniques used to detect the edges in the image.

Edge detection by gradient method

The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image. This method of locating an edge in a image is characteristic of the "gradient filter" family of edge detection filters which includes the Sobel method , Prewitt method, Robert method. A pixel location is declared an edge location if the value of the gradient exceeds some threshold. As edges will have higher pixel intensity values than those surrounding it. So once a threshold is set, then compare the gradient value to the threshold value and detect an edge whenever the threshold is exceeded.

Sobel Operator: It consist 3×3 mask as shown in fig 1.1 and the other is rotated by 90°

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

These are used to find the vertical and horizontal edges. These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by:

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

Typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

which is much faster to compute.

Prewitt's operator: Prewitt operator is similar to the Sobel operator and is used for detecting vertical and horizontal edges in images.

Prewitt's operator

1	1	1
0	0	0
-1	-1	-1

-1	0	1
-1	0	1
-1	0	1

+1	0
0	-1

Gx

0	+1
-1	0

Gy

Robert's cross operator:

Canny edge detection: Based on these criteria, the canny edge detector first smoothes the image to eliminate and noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at the maximum (non-maximum suppression). The gradient array is now further reduced by hysteresis. Hysteresis is used to track along the remaining pixels that have not been suppressed. Hysteresis uses two thresholds and if the magnitude is below the first threshold, it is set to zero (made a non edge). If the magnitude is above the high threshold, it is made an edge. And if the magnitude is between the 2 thresholds, then it is set to zero unless there is a path from this pixel to a pixel with a gradient above T2.

Edge detection by using morphological operator: Morphological operator provides fast and efficient computation. The basic morphological operation like erosion dilation provides the fast detection of the edges. The edges in image can be find by above morphological operator.

"**image = image - erode (image)**"

Image can be eroded by structuring element. Structuring element may be flat or non flat. For example structure element is-

0	1	0
1	1	1
0	1	0

Similarly different structuring elements can be used to erode and dilate the image.

Erosion and Dilation for binary image is defined as-

The **erosion** of a binary image *f* by a structuring element *s* (denoted $f \ominus s$) produces a new binary image $g = f \ominus s$ with ones in all locations (x,y) of a structuring element's origin at which that structuring element *s* fits the input image *f*, i.e. $g(x,y) = 1$ is *s* fits *f* and 0 otherwise, repeating for all pixel coordinates (x,y).

he **dilation** of an image *f* by a structuring element *s* (denoted $f \oplus s$) produces a new binary image $g = f \oplus s$ with ones in all locations (x,y) of a structuring element's orogin at which that structuring element *s* hits the the input image *f*, i.e. $g(x,y) = 1$ if *s* hits *f* and 0 otherwise, repeating for all pixel coordinates (x,y).

For grayscale images erosion and dilation is defined as-

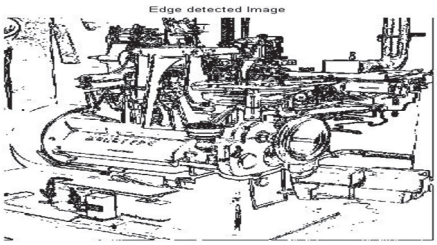
The erosion of f by a flat structuring element b at any location (x, y) is defined as the minimum value of the image in the region coincident with b when the origin of b is at (x, y). The dilation of f by a flat structuring element b at any location (x, y) is defined as the maximum value of the image in the region coincident with b when the origin of b is at (x, y).

Combination of both method: We can detect the edges by combining both above techniques gradient method and morphological operators. As here first we apply the canny edge detection and then apply the erosion operation. By this method noise is firstly remove from image by canny edge method and then edge is detected.

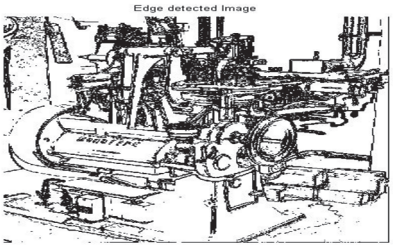
Results: Edge detection by using different techniques, results are shown below.

Conclusion: From result we can compare different edge detection techniques and conclude that using morphology the operation is become fast and efficient. Edges are clear than gradient but not much sharp. The combination of morphology and gradient for edge detection give the better result in comparison of using one method either gradient or morphology.

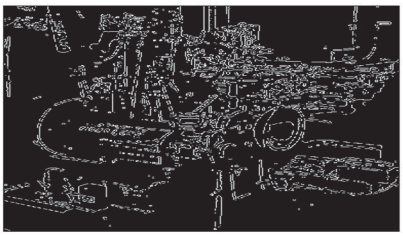
(a) Robert



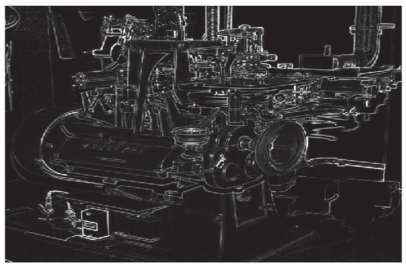
(b) Prewitt



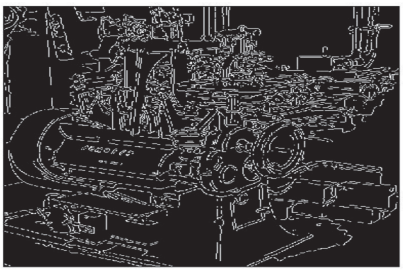
(c) Sobel



(d) Canny



(e) Using morphology



(f) Using canny and morphology

References:

1. Morphological image processing by by Gleb V.Tcheslavski:gleb@ee.lamar.edu http://ee.lamar .edu /gleb/ dip/index.htm Spring 2009 ELEN 4304/5365 DIP.
2. Introduction to grayscale morphology Jean Cousty MorphoGraph and Imagery 2011.
3. Gradient and edge detection by Robert Collins CSE486, Penn State.
4. http://www.altera.com/literature/cp/gspx/edge-detection.pdf

* * *

M.Tech(ECE),Student, Amity University UP
sengarnamita35@gmail.com