

Quality Comparison Between Edge Detection Method Based On Scale Sobel Canny and Good Image

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Abstract. Image processing is the processing of two-dimensional images through digital computers "(Jain, 1989). In image processing there are several steps that must be done, namely image acquisition, image enhancement (pre-processing), image segmentation, representation and description, then introduction and interpretation. Edge detection (edge detection) is one of the stages in image processing that aims to find out the pattern of image objects that kemudaian can be used in segmentation and extraction features on the image. In edge detection there are several methods that are quite popular among them is the canny and sobel method. In the process and result detection canny is superior with value 3,889 than sobel which only have value 3,667 based on goodness of image recommended from ITU 500-11. Keywords: Edge Detection, Canny, Sobel, scale of image goodness.

1. Introduction

1.1 Background

Computer Vision is a field of science which aims to create a useful decision regarding real physical object and a state based on an image. Computer Vision is a combination of image processing and pattern recognition. Image Processing Image Processing is "two-dimensional image processing through digital computer" (Jain, 1989), while according to effort (2000) said that "the image processing is a general term for a variety of techniques to manipulate and modify the existence image in various ways". In image processing, there are several steps that must be done image acquisition, image enhancement (pre-processing), image segmentation, representation and description, then recognition and interpretation. At this stage of image enhancement is done to get result a better image than the original image. The next step in image processing is image analysis (image analyst), aims to identify parameters-parameters that are associated with the trait (feature) of the object in the image, these parameters for subsequent use in interpreting the image. Image analysis is basically there are three stages: extraction image (feature extraction), segmentation (segmentation), and classification. A key factor in extracting the image is the ability to detect the presence of the edge (-edge) of the object in the image. Edge detection on the image / picture (Edge detection), is an area where there are changes in color intensity high enough. Edge detection process will do the conversion to this area into two kinds, namely intensity color value is low or high, for example zero or one. Edge detection will generate high value is found when the edges and low value otherwise. Interest do it object detection in image / picture is to determine the shape of an object contained in the image (Abdul Kadir and Adhi Susanto 2012). In the process of drawing the edges of objects detection there are several methods that can be used among them is the algorithm Canny and Sobel algorithm. Both of these algorithms have advantages and disadvantages that each is different in edge detection of objects so that the quality of detected edges of an object are different. For that I am interested to analysis and compare the quality of Canny edge detection algorithm, and the algorithm with Sobel in detection edges of objects in an image titled "Comparison Between Quality Edge Detection Method Based on Canny and Sobel Goodness Scale Image".

2. Literature and Theoretical

2.1 Review of the literature

To support this study, the researchers took several sources of previous similar studies in do it by previous researchers on edge detection on the object (Edge Detection). Research conducted by Johannes Widagdho and Achmad Wahid Kurniawan on "comparative method using edge detection with Laplace, Sobel and prewit, and Canny on pattern recognition". Pattern recognition is one branch of

artificial intelligence. In pattern recognition, there are several steps that must be passed. Steps must be passed in between is preprocessing, feature extraction, and the last one is the classification. Preprocessing is the process of distinguishing between objects with background. In the preprocessing stage most of the studies change the image of red Green Blue (RGB) into a grayscale image. In the feature extraction stage there are many methods to be applied, including edge detection using Laplace, Sobel Prewit, and Canny. In various studies that have been done, use Canny edge detection for the segmentation or feature extraction result obtain more accurate in comparison with other edge detection, after doing the feature extraction, the next stage is classification data. There are several methods used to classify the data, the simplest of which is by using k-nearest neighbors which such methods have the advantage of data that has a lot of noise (noise), and is effective for very large data. As for the distance measurements used math distance, because in some research use of math distance has a higher accuracy in comparison in comparison with euclidean distance. Pattern recognition is a science to classify or describe quantitative measurement (hash) or the main properties of an object. The purpose of pattern recognition is lowered group or category of patterns based on the characteristics possessed by the pattern, or in other words, patterns recognitin distinguish an object with other objects. Edge detection is an important part of the image analysis. Edge helpful object segmentation, registration and identification on the object. The points of the edge can be said as a change in the roughness level gray pixel. Edge detection is the process of finding a different intensity changes in an image field. Sobel operator is one of the main operators who avoid interpolation. This operator is more sensitive than the diagonal edges of the vertical and horizontal edges. Sobel operator using karnel 3x3 pixels. Canny operator is able to detect edges with minimum error rate. Unlike the other operator Canny edge detection using Gaussian Derivative karnel smoothes the edges of an image. Steps on Canny edge detection is:



Figure 1. Steps Canny Edge Detection.

The next research will be undertaken by DR.S. Vijayarani, Mrs. M. Vinupriya, titled "Performance Analysis of Canny and Sobel Edge Detection Algorithms in Image Mining" edge detection is an important technique, several algorithms have been developed in recent decades but there is no single algorithm that is suitable for all types of application. A major application in edge detection is the object in the image segmentation image. Folder edge assist in the representation of the face to be one entity. Edge detection has several provisions as in the figure below:

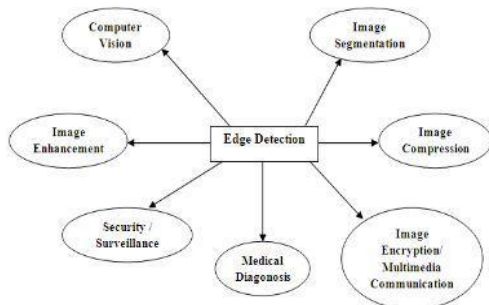


Figure 2. Provisions Edge Detection System
Generally, edge detection, there are 3 steps:

1. Filtering

Some edge detection of classical works just fine with the picture quality is quite high, but not good enough for the noise to the object's image because it can not distinguish between edges that have significance different. Noise on the edges of objects.

2. Improved

image quality improvement techniques aim to get a better picture quality than the original image. Linear filter is used to improve image quality, but not all the images could be solved using linear techniques.

3. Detection

Many images have zero value for the gradient, and all these points are not detected as an edge. Some methods do to detect the edge.

Canny Edge Detection is one edge detection method most commonly used in image processing, with detection with a very deep and strong. Canny edge detector is widely considered to be used as edge detection methods standard in the industry. The steps used in the Canny edge detection is Smoothing, finding gradients, non-maximum suppression, double thresholding, and edge tracking. Sobel edge detection algorithm works by using a mathematical procedure called convolution and generally analyze derivative or second derivative of the digital numbers through the gap space. We apply the method for edge detection Sobel, who three basic pieces with 3 array on the move over the main image.

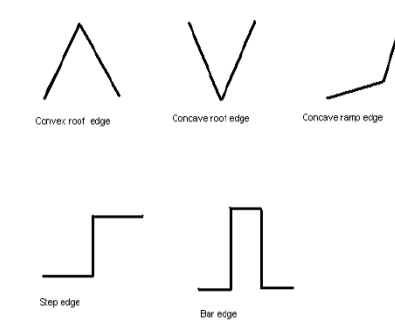


Figure 3. The Types Of Edges Of Objects

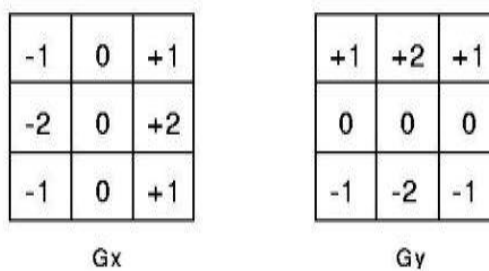


Figure 4 Konfolusi Karnel On Sobel

Edge detection is the result of the analysis, Canny edge detection is better than Sobel edge detection.

Table 1. The results of performance comparisons Canny and Sobel

Algorithms	Confusion matrix	
	Accuracy (in %)	Matrix
Sobel	75%	4 0 2 2
Canny	87.5%	6 1 0 1

Research subsequently done by Rohmad Raharjo, et al in 2013, entitled "Implementation of Improved Edge Detection Canny with Ant Colony Optimization" edge detection in the image aims to do extraction of essential features of an image for example the line, arch, tip. The results of the extraction will be used for high-level computer vision. For example, in the pattern recognition. Real Implement on edge detection for computer vision algorithms among others face recognition. When this has been known some between edge detection method is Sobel, homonorpic, and canny. An important point to note in edge detection is the degree of spatial accuracy and sensitivity. by C. Lopez Molina most relevant methods are canny, both methods in getting the edge detection detection criteria that were found by Jhon Canny, namely a low error rate and accurate determination of the edge of a unique response, but for some conditions, the detection method traditional still has the disadvantage that the risk of error detection and edge a broken edge.

To overcome these deficiencies in 2008, Chen proposed improved edge detection method traditional using graph algorithms approach Ant Colony Optimization (ACO). With this method, the expected result is not optimal edge detection can be improved. There edge repairs done is to thicken the edges and the connecting edges are broken. Canny improvement with ACO divided into three (3) phases: Phase preparation only able to complete the optimization if the problems in the form of a graph. Evaluation phase process performed Colonies are all ants how many at the starting point start searching graft. In the search process every ant, choose the goal then renew the condition of colonies are presented. Some ACO parameters must be defined at the outset. When an ant is in the mode i paths that may exist in the mode of mode i and j meet. $n_{ij} = (VP(i)) / (MAX \{1, |p_j - p_i|\})$ at (1), P_i shows pheromones in node i, and j -showing intensity pheromones in the node and to-node circuited with the node. With the value of $V(P_i)$ corresponding with (2) [2]. Evaluation phase columns and lines that produced by a search of ants in comparison with termination condition which produced a total of the whole algorithm. Based on the results of testing that has been done in obtaining the conclusion that the ACO method is able to be made to improve the method of edge detection method Canny to improve the image of the canny edge detection on average 12.05% of the canny edge detection.

3. Results and Discussion

3.1 Results

In testing the canny edge detection algorithm and the image of this Sobel algorithm researchers used nine test images were divided into three images of characters, 3 facial image, and 3-image forms. digital image recorded using the smart phone's camera with a resolution (400x400) pixels. The edge detection stages are as follows:

1. Acquisition of the image
acquisition process citra do using a smart phone camera with image resolution of 400x400 pixels.
2. Normalization color (grayscale)
After successfully recorded digital image of the next step is to normalize the color (grayscale).by the

$$s = \frac{r + g + b}{3} \quad (1)$$

Remarks formula: S = grayscale image
r = red
G = green
b = blue

3.1.1 Edge detection

Edge detection In the process of using two algorithms, namely:

1. Canny

In the early stages of screening performed on the image with the aim to remove noise. This can be done by using a Gaussian filter. After smoothing the image of the noise carried out, a process to obtain the edge strength (edge strength). This is done by using thresholding.

Furthermore, the gradient image can be calculated by the formula:

$$|G| = |G_x| + |G_y| \quad (2)$$

Description: G = gradient image

Gx = Horizontal gradient

Gy = Vertical gradient third step form of counting toward the edges.

Once the edge direction is obtained, the removal of non-maximum implemented. The elimination of non-maximum is done along the edge in the edge direction and eliminate the pixels (pixel is set to 0) that is not regarded as an edge. In this way, obtained a thin edge. The next step in the form of edge detection process This process eliminates lines such as halting the edges of objects. By using two threshold Tepi1 and Tepi2. then, all image pixels greater value than Tepi1 considered as edge pixels. Furthermore, all of the pixels connected to the pixels and have a greater value than Tepi2 also considered as edge pixels and edge pixels with pixel weak become strong.

2. Sobel

Sobel operator using NxN matrix with ordo 3 x 3 matrix as is used to make it easier to get the center pixel so that a central point matrix (aij). The central pixel is a pixel to be examined. How to use this matrix as the use of a grid, that is by inserting pixels around being examined (pixel center) into the matrix. How were called spatial filtering.

Table 2. Matrix 3 x 3 on the image area

a ₀	a ₁	a ₂
a ₇	a _{ij}	a ₃
a ₆	a ₅	a ₄

is defined Gy as the direction of the search vertical

$$G_y = (a_0 - a_6) + (a_2 - a_4) + 2(a_1 - a_5) \quad \dots\dots (3)$$

$$G_y = (a_0 + 2a_1 + a_2) - (a_4 + 2a_5 + a_6)$$

and Gx as a search horizontal direction

$$G_x = (a_0 - a_2) + (a_6 - a_4) + 2(a_7 - a_3) \dots\dots, (4)$$

$$G_x = (a_0 + 2a_7 + a_6) - (a_2 + a_4 + 2a_3)$$

using the definition of absolute value given

$$G = |G_x| + |G_y| \quad \dots\dots\dots (5)$$

By comparing the area above equation (3) can be seen that Gy is different between the first row and the third row, where the element nearest aij namely (a1 and a5) more than twice compared with a value of around it (this is based on intuition region / area0 also in the equation (4), Gx is different between the columns a3 and a7. Gx is the direction of x and Gy is the direction of y. equation of (3) and (4) can be implemented from operations Sobel obtained value of the equation (5) . Mechanical spatial filtering uses an matrix addition is called the mask. the size of the matrix mask is equal to the matrix of pixels that is NxN. in the mask is essentially stored type of surgery to be performed on a matrix of pixels, but not all filter spatial filtering using the mask to keep its operations .Sobel operator is applied in two mask, is as follows:

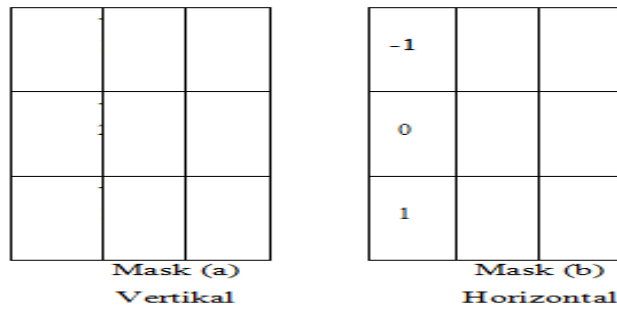


Figure 5. Mask 3x3 Sobel

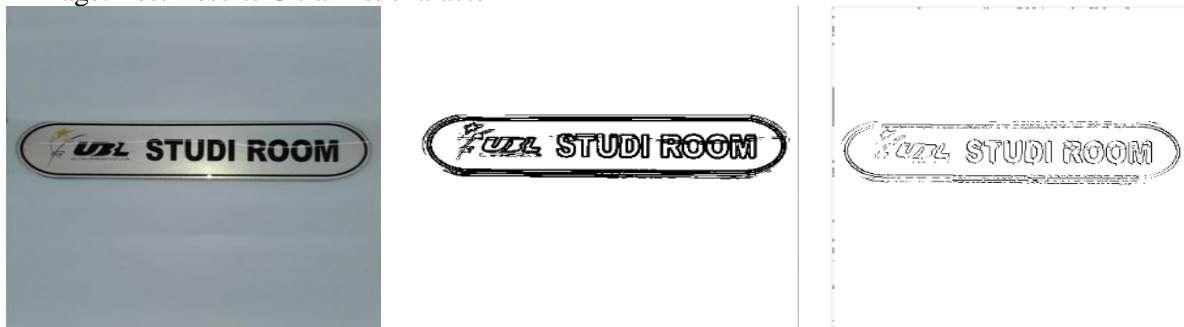
Mask first is the mask (a) is used to calculate difference point p no vertical sides so that the resulting search point vertical direction. The second mask is the mask (b) is used to calculate the difference between a point on the horizontal side of the search results point to produce a horizontal direction. When the edge found is a set of significant pixels that make up an object image, the color pixels will be affirmed again, meaning that the pixels will be on view in intensity so that this edge colors will be apparent. Such edge state will show an object in the image.

3.2 Discussion

In testing canny edge detection algorithm and Sobel are using 9 test images. Then do the object image edge detection using Canny algorithm and the algorithm then proceeds Sobel edge detected measured subjectively using a scale with kindness Citra by human vision. The parameters in the test is the clarity of the edge detection, and a lot of noise (noise) is detected in the image.

3.2.1 Results of Tests on character

A image. Test Results Citra first character



The original image of The image of detected Canny Image detected Sobel

Figure 6. image of the character test results 1

On testing the image character 1 obtained results of edge detection Canny and Sobel ratio as follows:

a. Number test parameters Test results image character1

Table 3. Analysis and testing of edge detection in the image of the character 1

		Test results image character1			
		Canny		Sobel	
test parameters		Results	the	results for	Value
1	Noise detected	Seen but not intrusive	4	Seen but not intrusive	4
2	Clarity edge detected	Good	4	Good	4
Average			4		4

explanation:

At the edge of the image is detected Canny and Sobel have the accuracy of edge detection is the same difference both are on the edge of the line is detected, the detected edge canny edge is thinner than the edge Sobel detected so that the edge looks in more detail;

In a digital image edge detection between Canny and Sobel both can produce a good edge.

b. Test Results The image of the character 2



Citra original

image is detected Canny

image detected Sobel

Figure 7. The test results of the image of the character 2

On testing the image of the character 2 obtained results of edge detection Canny and Sobel ratio as follows:

Table 4. analysis and testing of edge detection in the image of the character 2

Number	of test parameter	test resultskarakter2 image			
		Canny Results	T he	Sobel results for	V al ue
1	Noise detected	Visiblebut not menggenggu	4	Seen but not menggen	4
2	Clarity edge detected	Very Good	5	Very Good	5
Average			3.5	3.5	

explanation:

On the edge detection Sobel image 2 characters can display the results of the edges of objects with a clearer and brighter than the canny. In a second character image edge detection between Canny and Sobel both can produce good edge. Both operators only show a little noise (noise) but does not interfere with the edges of objects detected.

c. Test Results The image of the character 3

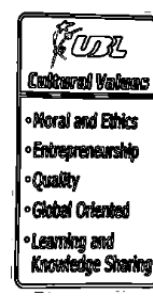


image original

image is detected Canny

image detected Sobel

Figure 8. the results of a test image of the character 3

On testing the image of characters 3 obtained the results of edge detection Canny and Sobel ratio as follows:

Table 5. analysis and testing of edge detection in the image of characters 3

test resultskarakter3 image						
Nu mb er	of paramete rs	test	Canny		Sobel	
			Results	T h e	results	V al u e
1	Noise detected		Visiblebu t not menggen ggu	4	Looks a little disturbi ng	3
2	edge detected Clarity		Good	4	Good	4
average				4		3. 5

explanation:

On the edge detection character image 3 Sobel produce object edges are thicker than the canny so that the characters were detected visible fused. Canny edge detection can detect the edges with thinner margins so as to distinguish the object 1 and object 2 when the two objects close together.

From the test results of each image of the characters that have been tested then the average value of the edge is detected and the removal of noise (noise) is as follows:

Table 6. Measurement results of edge detection image of characters

Numbe r	Imagery Test	results of the comparison image of the character of				
		Canny			Sobel	
		N o i s e	B o d y	averag e	N o i s e	The averag e
1	image character	4	4	4	4	4

1						
2	Citra karakter2	4	5	3.5	4	5 3.5
3	image karakter3	4	4	4	3	4 3.5
Average		4	3	3.167	3	3
		4	3	3.167	6	3 4,0
		3	7	3	6	3

3.2.2 Results of Tests on face a image. Test Results Citra Face 1



image original



image is detected Canny



Sobel image is detected

Figure 9. test results image 1face

3.3 Comparison Results canny edge detection method and Sobel

From each image that has been tested and using the measuring scale with goodness image recommended by ITU 500- 11, the obtained results of the comparison as follows:

Table 7. comparison canny edge detection and Sobel

Number	Category image	comparison				
		Canny			Sobel	
		Noise	edge	average	Noise	Bank average
1	image character	3.167	3.66		4	3.0
2	face image	4	4	4	2.667	3:33
3	image forms	3.667		3.667	3.33	3.67
	average	3.778		3.889	3.332	3.667
		3.944				

Note:

The removal of noise (noise) canny edge detection obtained Sobel value of 3.889 while only 3.332. So it can take the conclusion that the canny edge detection better than Sobel in removing noise (noise); From the result of canny edge detection gets the average value is 3.778, while Sobel is 3. Can take the conclusion that the detection accuracy of the edges of objects in the entire image edge detection Sobel better daripada canny edge detection. The overall result of the image that has been tested and the canny edge detection Sobel with kindness scale image recommended by ITU 500-11 is canny has edge detection accuracy with a value of 3.889 while 3.667 Sobel so it can be deduced that the canny edge detection is better than detection Sobel edge.

4. Conclusion

The overall results of the image that has been tested and the canny edge detection Sobel with kindness scale image recommended by ITU 500-11 is a canny edge detection method has the edge accuracy and noise removal with a value of 3.889 while Sobel edge detection method 3.667 so as to The deduced that the canny edge detection better than Sobel edge detection.

4.1 Suggestions

Apart from the contribution provided in this study, in order to improve further, particularly with respect to methodology study, researchers intend to convey some suggestions as follows:

- A. In the image processing (image processing) has been known that the edge detection is the best among Canny and Sobel is a method canny, so it is advisable when building image processing applications using the canny edge detection object image.
- B. Researchers hope further research done in comparison object image edge detection using other methods that are more complex.
- C. Researchers hope this study can be a source / reference for other studies in conducting comparative edge detection method uses the goodness scale image recommended by ITU 500-11.

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