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COMPARISON CANNY AND SOBEL METHODS DETECTING EDGES OF DENTAL CARIES

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Abstract: In the human body there are parts that act as tools for tearing and tearing food which are commonly called teeth, teeth are sharp and hard parts of the body. Dental caries is the medical term for cavities, dental caries is an infectious disease that damages the hard lining of the teeth. The presence of bacteria or germs found in the oral cavity causes cavities in the teeth. Medical images are useful for seeing the extent of the damage to cavities. Not all images have good quality detection results or have noise. Therefore, Image Processing is used by applying the Canny and Sobel method of edge detection to an image in order to process the results of segmentation and object identification in dental caries images. There are many operators in edge detection, including the Roberts Operator, Prewitt Operator, Laplacian Operator and Laplacian of Gaussian (LOG). The purpose and benefits of establishing an image processing application using Matlab software with the Canny and Sobel method to produce the appearance of an object's boundary line in an image. The results of this study can be concluded from the two operators regarding the advantages and disadvantages of the two operators.

Keywords: dental caries; edge detection; image; matlab; canny method; sobel method

Abstrak: Pada tubuh manusia ada bagian yang berperan sebagai alat untuk merobek dan mengoyak makanan yang biasa disebut dengan gigi, gigi merupakan bagian tubuh yang tajam dan keras. *Karies* gigi adalah istilah medis dari gigi berlubang, *karies* gigi merupakan penyakit infeksi yang merusak jaringan lapisan keras gigi. Adanya bakteri atau kuman yang terdapat pada rongga mulut menjadi penyebab gigi menjadi berlubang. Citra medis berguna untuk melihat sejauh apa kerusakan pada gigi yang berlubang. Tidak semua citra memiliki hasil pendeteksian yang bagus kualitasnya atau memiliki derau (*noise*). Oleh sebab itu digunakanlah Pengolahan Citra dengan menerapkan deteksi tepi metode Canny dan Sobel pada suatu citra guna untuk memproses hasil segmentasi dan identifikasi objek pada citra karies gigi. Ada banyak operator dalam deteki tepi, diantaranya yaitu, Operator Roberts, Operator Prewitt, Operator Laplacian dan Laplacian of Gaussian (LOG). Tujuan dan manfaat dari dibentuknya sebuah aplikasi pengolahan citra menggunakan software Matlab dengan metode Canny dan Sobel untuk menghasilkan penampakan garis batas suatu objek pada citra. Hasil dari penelitian ini dapat disimpulkan dari kedua operator mengenai kelebihan dan kekurangan dari kedua operator tersebut.

Kata kunci: citra; deteksi tepi; *karies* gigi, matlab, metode canny, metode sobel

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INTRODUCTION

Caries, commonly called cavities, is a disease in which bacteria destroy the structure of tooth tissue causing cavities. Based on data obtained from the Semarang City Health Office, the number of caries sufferers in 2014 was 2003 cases with the highest percentage in the age group 20-44 years in 2013 which was 41% (824 cases), the age group 5-19 years was 20%. (397 cases), and the age group 0-4 years as much as 6% (114 cases).[1]

Efforts that can be made to prevent caries is by brushing your teeth, brushing your teeth really needs to be done because if caries occurs this incident usually continues until children enter their teenage years and even into adulthood the reduced teeth will attack the permanent teeth before the teeth penetrate the gums.[2]

Previous studies have been conducted to identify dental caries from image processing results, but the number of studies is still minimal. One of them is the research on Panoramic Radiograph Image Processing on the Detection of Human Tooth Filling. In this study, the percentage obtained from the program dataset indicated that the accuracy indicated for tooth filling was 87.93%, the precision value was 88.7% and the sensitivity value was 96.6% of 116 data tested.[3]

Identification research Comparative Analysis of Image Quality Improvement on Batik Motifs Using the Robert, Sobel, Canny Edge Detection Concept succeeded in obtaining an accuracy rate of 80% for the Canny operator. While the operator Robert with a percentage of 40% and 60% Sobel operator.[4]

Research Identification of comparison of edge detection methods using the canny, prewitt and sobel methods on fish images. Based on the accuracy of content based image retrieval on the distance query value, the canny edge detection results obtained better edge detection 75.39% compared to prewitt 76.09% and sobel 74.67% with a sample of 100 data fish image.[5]

In the tests that have been carried out using testing data that is different from the training data, the level of pattern recognition of motifs in the test using 210 training data produces an accuracy of 56.67%. The training data is then improved by using 240 images, resulting in an accuracy of 66.67%. Finally using 270 training data and producing an accuracy of 66.67%.[6]

Testing from cancer staging level diagnostic research on colposcopy results using the canny edge detection operator, the test results show that the canny operator can carry out the edge detection process quickly with a running time value of 0.0589809 ms, for an average MSE value smaller means the level The image similarity is greater, namely 11296.3. The system validation based on the doctor's diagnosis is only 2 images that do not match, so the percentage of system accuracy is only 80%.[7]

The experimental results of the ultrasound image segmentation process of the two-dimensional fetus using the Prewitt and Canny research methods, based on research on 35 fetal ultrasound input images, the results of image conformity detected using the Canny method obtained an accuracy of around 65%. Meanwhile, the Prewitt method yields an accuracy of around 62%.[8]

The LoG + Canny method detects fingerprint images has better accuracy than the Canny and LoG methods. This is evidenced by the results of image identification which reached 90.7%.[9]

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In this study, facial images were used as a database with a sample of 20 people and 7 facial positions, 3 facial image shooting distances, and 5 lighting categories. The testing process resulted in a direct recognition rate of 66.43%, while indirect testing was 82.86%. The indirect FAR/FRR error rate is 45% with a threshold value of 0.107%, and directly 50% for the FAR/FRR value at a threshold value of 0.104%[10]

This study aims to compare the results of the Canny and Sobel method with the dental caries object, which method is better to see the damage from the dental caries.

METHOD

Data Collection Techniques

Research methodology is a science that studies to collect data by observing with the right thinking in an integrated manner so that it can go through scientifically arranged stages to search, compile and analyze and conclude data so that it can be used to find, develop and test the correctness of a data. .

In collecting data, several techniques are needed to support the data collection process, namely:

a. Documentation Study
   Documentation study is one of the many qualitative data collection methods to obtain an overview from the subject's point of view through a written medium. Documentation studies can be in the form of writings, pictures, diaries, life histories, regulations, policies or monumental works of a person.
b. Literature review
   Literature study is a technique for finding information related to theory, the information that has been collected will be used as a reference in solving problems, literature study can use references from computer science books, national journals, international journals, scientific papers, ebooks, information and the internet browsing.

Dental Caries

In the human body there is a part that acts as a tool for tearing and tearing food which is commonly called teeth. Dental caries is the most common dental health disorder caused by bacteria and causes teeth to become porous, hollow and broken resulting in less than optimal growth[11]**.**

At present, there has not been anyone who focuses on identifying dental caries using a comparison of the Canny and Sobel methods. Therefore, this study aims to build a system that is able to compare the results of which edge detection is better, so that future studies can determine which method to use to identify dental caries with better accuracy.

Image Processing

Image processing is a field of science that studies how an image is formed, processed, and analyzed so as to produce information that can be understood by humans[12]. Image processing is image processing that uses a computer to change the original image into a better-quality image. In image processing there are several operations performed to convert the original image to the resulting image, image processing operations are classified as follows:

1. Image Enhancement
   Image quality improvement operations aim to manipulate image parameters to improve image quality, image quality improvement operations improve several images, in-

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cluding: dark / light contrast correction, object edge repair, sharpening and giving false colors.

2. Image Compression
   The image compression operation aims to present images in a more compact form that requires less memory but still maintains good image quality.
3. Image Segmentation
   Image segmentation operation is closely related to pattern recognition so that image segmentation operation aims to break an image into several segments with certain criteria.
4. Image Analysis
   Image analysis operation aims to calculate the quantitative magnitude of the image to produce its description. Some examples of image analysis operations are object edge detection, boundary extraction andregional representation.
5. Image Reconstruction
   OperationImage reconstruction is widely used in the medical field so that image reconstruction surgery has the goal of reshaping objects from the resulting image.

Digital Image

A digital image is a two-dimensional image resulting from a continuous two-dimensional analog image through a sampling process. A digital image is an image that can be processed by a computer because it is in the form of numerical data[13].

a. Color Image (RGB)
   An RGB (Red, Green, Blue) image consists of three separate image fields, each consisting of the main colors, namely: red, green and blue in each pixel. The combination of red, green and blue intensity determines the color of each pixel.
b. *Grayscale*
   To change a full color (RGB) image to a grayscale image (gray image). R: Red color elements, G: Green color elements, B: Blue color elements The values generated from the above equation will be input to each basic color element of the grayscale image.
c. Binary
   A binary image is a digital image with two possible pixel values, namely object pixels with a value of 1 and background pixels with a value of 0.

Edge Detection

Edge Detection is a set of pixels that are connected and lie on the boundary of two areas. Edge detection functions to obtain the edge of an object, edge detection utilizes a drastic change in the intensity value at the boundary of two areas[14].

Canny method

The Canny method is a method known as the optimal edge detection operator because the Canny algorithm has a low error rate, the pixel distance found in the Canny edge detection is very short so it gives one response and one edge.[15].

$$|G| = |Gx| + |Gy| = 0$$

Gx

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

Gy

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

Sobel method

The Sobel method is a development of Robert's method using HPF (High Pass Filter) in which this method has the ability to reduce noise before per-

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forming edge detection calculations. This operator uses the 3x3 kernel for calculations[16].

$$\sqrt{Sx^2 + Sy^2}$$

Gx

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

Gy

1	2	1
0	0	0
1	2	1

Image 1. Image Caries

RESULT AND DISCUSSION

Application of the Canny Method

The application of the Canny method uses matrix multiplication which is commonly called convolution, where this convolution technique aims to clarify the image by replacing the pixel values that match or are close to the original pixels.

$$\begin{bmatrix} \mathbf{63} & \mathbf{64} & \mathbf{66} & 56 & 56 \\ \mathbf{67} & \mathbf{65} & \mathbf{64} & 57 & 57 \\ \mathbf{65} & \mathbf{62} & \mathbf{59} & 58 & 59 \\ 59 & 56 & 53 & 60 & 60 \\ 56 & 54 & 53 & 61 & 61 \end{bmatrix}$$

Gx

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

Gy

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

Calculating the convolution value with the Canny method on the image:

a. The first convolution is performed on pixels worth 59 (the center point of the mask)

$$Gx = (66)(-1) + (2)(64)(-1) + (59)(-1) - (63)(1) + (2)(67)(1) + (65)(1) = -117$$

$$Gy = (63)(-1) + (2)(64)(-1) + (56)(-1) - (65)(1) + (2)(62)(1) + (59)(1) = -129$$

$$|G| = |Gx| + |Gy| = -246 = 0$$

Application of the Sobel Method

The application of the Sobel method uses matrix multiplication which is commonly called convolution, where this convolution technique aims to clarify the image by replacing the pixel values that match or are close to the original pixels.

$$\begin{bmatrix} \mathbf{63} & \mathbf{64} & \mathbf{66} & 56 & 56 \\ \mathbf{67} & \mathbf{65} & \mathbf{64} & 57 & 57 \\ \mathbf{65} & \mathbf{62} & \mathbf{59} & 58 & 59 \\ 59 & 56 & 53 & 60 & 60 \\ 56 & 54 & 53 & 61 & 61 \end{bmatrix}$$

Gx

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

Gy

1	2	1
0	0	0
1	2	1

Calculating the convolution value with the Sobel method on the image:

a. The first convolution is performed on pixels worth 59 (the center point of the mask)

$$Sx = (66)(1) + (2)(64)(2) + (59)(1) - (63)(-1) + (2)(67)(-2) + (65)(-1) = 111$$

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$$Sy = (63)(1) + (2)(64)(2) + (66)(1) - (65)(-1) + (2)(62)(-2) + (59)(-1) = 143$$

$$\sqrt{Sx^2 + Sy^2}$$

$$\sqrt{111^2 + 143^2} = 181 = 32$$

Testing this system will be carried out using black box testing techniques. This technique is used to test the entire display (form or page) in the built application whether it is functioning properly or not. The following are the results of testing using the black box testing technique.

Table 1. Testing Black Box

Test	Table Column Tile		
Name	*Test Case*	Canny	Sobel
Caries Molar			
Caries Front Teeth			
Caries Wisdom Teeth			
Caries milk teeth			

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Accuracy=
cy= $\frac{The\ number\ of\ data\ results\ detected}{Amount\ of\ data} \times$ 100%

Accuracy Canny $= \frac{3}{4} \times 100\% = 75\%$

AccuracySobel= $\frac{2}{4} \times 100\% = 50\%$

Based on the results of the method comparison test on the previous page, it can be seen that the results from the Canny method have an abstract border, while the results from the Sobel method have a clearer outline. So it can be concluded from the comparison of these methods, the Sobel method is better used for edge detection of medical images because it has clearer edge results.

CONCLUSION

After testing the program on several input images and comparing the results, it turns out that the method with the best results is the Sobel method, where the desired medical image is in the form of a thin line compared to the Canny method which still has thick lines and the edges are not too clear.

In this study the percentages obtained using the Canny method obtained a percentage accuracy rate of 75% and using the Sobel method obtained a percentage accuracy rate of 50%.

Implementing the results of comparative theoretical research of the Canny and Sobel methods into an application of comparative analysis between the two methods.

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