DESIGN OF DIGITAL IMAGE EDGE DETECTION APPLICATIONS USING FREI-CHEN ALGORITHM

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ABSTRACT

One image processing technique used is edge detection. Edge detection is a common thing in digital image processing because it is one of the first steps in image segmentation, which aims to present the objects contained in the image. Edge detection functions to identify the boundary lines of an object against overlapping backgrounds. Currently several methods can be used for edge detection, for example the Sobel, Canny, Prewitt, Frei-Chen, and SUSAN methods. In this research, 1 method is taken, namely the Frei-Chen algorithm. The results of this study indicate that this operator is successful in detecting edges in an image. When detecting edges in images containing noise the Frei-Chen algorithm is better at edge detection.
Keywords: detection, image, Freichen

1. Introduction

The eye is one of the five senses that humans use to see. But the human eye has limitations in capturing electromagnetic signals. Therefore, a computer or imaging machine was created that could capture almost all electromagnetic signals. Imaging machines can work with images from sources that are incompatible, unsuitable, or cannot be captured with human vision. This is what causes digital image processing to have very broad uses. Image processing technology can enter various fields such as medicine, geology, marine, industry, and so on. [1]

One image processing technique used is edge detection. Edge detection is a common thing in digital image processing because it is one of the first steps in image segmentation, which aims to present the objects contained in the image. Edge detection functions to identify the boundary line of an object against an overlapping background. So that if the outline on the image can be accurately identified, all objects can be found and basic properties such as area, shape, and size of the object can be measured. Image edge is the position where the pixel intensity of the image changes from a low value to a high value or vice versa. At present there are several methods that can be used for edge detection, for example the Sobel, Canny, Prewitt, Frei-Chen, and SUSAN methods. In this study 2 methods were taken for comparison, namely the Frei-Chen algorithm and the SUSAN algorithm. Frei-Chen is an edge detection method using the Frei-Chen mask which contains a vector calculation basis to be applied to images. Frei-Chen showed that edge detection is best done by a simple edge detector, followed by thinning and connecting processes to optimize the edge. This description will provide an overview of the application of both methods in detecting edges in an image, as well as evaluating the performance of each algorithm. [2], [3]

2. Literatur Riview

Image is a representation (picture), similarity, or imitation of an object. Image as the output of a data recording system can be optical in the form of photos, analogous in the form of video signals such as images on television monitors, or digital that can be stored on a storage medium Image analysis aims to identify the parameters associated with the characteristics of objects in the image, for the next parameter is used in interpreting the image. Image analysis consists of three stages namely feature extraction, segmentation, and classification. The key factor in extracting features is the ability to detect the presence of edges of objects in the image. After the edge of the object is known, the next step in image analysis is segmentation, which is to reduce the image to an object or region. The final step in image analysis is classification, which is mapping different segments into different object classes. Detection of edges is the first step to encompass information in an image. Edge characterizes the boundaries of objects, therefore it is useful for the process of segmentation and identification of objects in the image. The purpose of edge detection operations is to increase the appearance of the boundary lines of an area or object in the image.[4], [5]

Edge detection using the Frei Chen mask is implemented by mapping the intensity vector using a linear transformation and then detecting the edge based on the angle between the vector's intensity and projecting it into the edge space. Frei Chen mask is a unique mask, which all contain vector bases. This is implemented in the 3X3 image area represented by the number of nine Frei Chen masks. Generally, the points to be processed along with the points around them are entered into a 2-dimensional matrix which will be of size N x M. This matrix is called a neighbor matrix where the filter dimensions are generally multiples odd because the point to be processed is placed in the neighbor of the matrix. For convolution imagery written: [6]–[9]

h (x, y) = f (x, y) x g (x, y)

Information :

h (x, y) is the result of the convolution

f (x, y) is the matrix to be processed

g (x, y) is the kernel matrix [10]

3. **Results and Discussion**

Analysis and design of the application requires systematic steps to get a good application and by its objectives. The initial stage of the analysis is to analyze the algorithm that will be used. As for the application design stage, namely, interface design. Frei-Chen masks are base units of vectors. It can be represented on every 3x3 subimage as the sum of 9 Frei-Chen masks. Every image that has been determined is carried out a projection process that is similar to the convolution process, where the convolution process is a process where the image is manipulated using an external mask to produce a new image. The images to be processed can be seen in the image below.

Figure 1 Processed Image

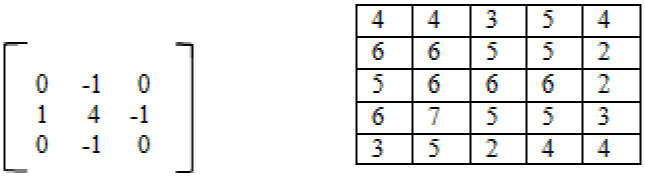
At this stage, a conversion process from digital image into a matrix will be carried out. Where the data to be processed must be converted first so that the process is in accordance with the algorithm used. In this process the matrix used is a matrix with a size of 5 x 5. The matrix formed from the image above can be exemplified as shown below.

$$\mathbf{f(x,y) =} \begin{bmatrix} 4 & 4 & 3 & 5 & 4 \\ 6 & 6 & 5 & 5 & 2 \\ 5 & 6 & 6 & 6 & 2 \\ 6 & 7 & 5 & 5 & 3 \\ 3 & 5 & 2 & 4 & 4 \end{bmatrix}$$

1. Determine the kernel used to detect images

$$g(x,y) \begin{bmatrix} 0 & -1 & 0 \\ 1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

2. Calculate the convolution value of the image



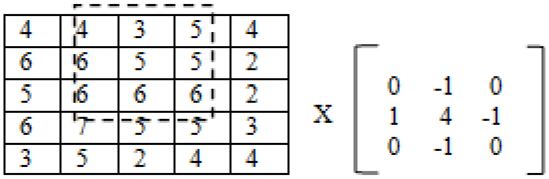
$$\begin{bmatrix} 0 & -1 & 0 \\ 1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

4	4	3	5	4
6	6	5	5	2
5	6	6	6	2
6	7	5	5	3
3	5	2	4	4

Convolution result = 3. This value is calculated in the following way: (4 x 0) + (4 x -1) + (3 x 0) + (6 x-1) + (6 x4) + (5 x-1) + (5x 0) + (6 x -1) + (6 x 0) = 3

	3			

3. Slide the kernel one pixel to the right, then calculate the pixel value at position (0.0) of the kernel



4	4	3	5	4
6	6	5	5	2
5	6	6	6	2
6	7	5	5	3
3	5	2	4	4

$$\times \begin{bmatrix} 0 & -1 & 0 \\ 1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Convolution result = 0. This value is calculated in the following way: (4 x 0) + (3 x -1) + (5 x 0) + (6 x-1) + (5 x 4) + (5 x -1) + (6 x 0) + (6 x -1) + (6 x 0) = 0

	3	0		

4. Slide the kernel one pixel to the right, then calculate the pixel value at position (0.0) of the kernel

4	4	3	5	4
6	6	5	5	2
5	6	6	6	2
6	7	5	5	3
3	5	2	4	4

X

$$\begin{bmatrix} 0 & -1 & 0 \\ 1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Convolution result = 2. This value is calculated in the following way: (3 x 0) + (5 x -1) + (4 x 0) + (5 x -1) + (5 x 4) + (2 x -1) + (6 x 0) + (6 x -1) + (2 x 0) = 2

	3	0	2	

5. Next slide the kernel or pixel down, then start the convolution from the left side of the image again. Each time you convolute, move the kernel one pixel to the right.

4	4	3	5	4
6	6	5	5	2
5	6	6	6	2
6	7	5	5	3
3	5	2	4	4

X

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Convolution result = 0. The value is calculated in the following way: (6 x 0) + (6 x -1) + (5 x 0) + (5 x -1) + (6 x 4) + (6 x -1) + (6 x 0) + (7 x -1) + (5 x 0) = 0

	3	0	2	
	0			

6. Next slide the kernel one pixel down, then start again to convolution from the left side of the image. Each time you convolute, move the kernel one pixel to the right

4	4	3	5	4
6	6	5	5	2
5	6	6	6	2
6	7	5	5	3
3	5	2	4	4

X

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

3. Conclusions

The algorithm used in edge detection, the free algorithm to detect edges in an image, is quite reliable, because it manages to separate objects from the background so as to produce objects that match the original image. When edge detection on a given image is noise, the frei-chen algorithm is quite good at detecting edges.

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