

The Implementation of Image Smoothing to Reduce Noise using Gaussian Filter

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ABSTRACT

Nowadays information is very important and needed, especially for an image, but an image that we have often contains noise, such as black and white grains. To overcome this problem, it is possible to use image smoothing that image captured becomes smoother and is easier to be seen by one's eyes. The method used is Gaussian filtering. Gaussian filtering aims to decrease noise in an image. In this study, it uses an image affected by noise which is belong to Gaussian noise, Salt and Pepper noise, and Speckle noise. This study aims to smooth an image by decreasing noise on an image affected by noise that it becomes better than before. From the result of image reduction, it is possible to get the best image which has high value (RMSE:19.2960 db, PSNR:35.2761 db, SNR:30.9538 db) and in the experiment 1. jpg has a low value (RMSE:1185.5739 db, PSNR:17.3915db, SNR:13.2861db).

General Terms

Image Smoothing, Gaussian Filtering, Noise Reduction

Keywords

Image Smoothing, Gaussian Filtering, Noise reduction

1. INTRODUCTION

1.1 Background

Data or information is not only presented in a text format, but it is also possible to be presented in an image, audio, and video format. Those data is generally called Multimedia. In this information and technology era, all cannot be separated from Multimedia. Image is a representation, similarity, imitation of an object. Image which is well-known in computer is a digital image. Digital image can get a low quality or problem. Problem in a digital image is generally called noise. Noise is a problem caused by digital data storage which received by image data receiver which decrease image quality. Noise can be caused by optical instrument problem in image receiver, such as photo lens which is full of dust or unsuitable image process. There are three kinds of noise, namely Gaussian Noise, Salt and Pepper Noise, and Speckle Noise.

Operations used in image processing are so various. Image processing operation generally can be classified in some groups. One of them is image smoothing. Image smoothing is an operation aiming to improve image quality by manipulating image parameter and is a way to disappear noise. There are some methods of image smoothing. One of them is Gaussian filtering. Gaussian filter is one of filter using mathematics formula to create autofocus effect to reduce detail and create foggy effect determined by sigma value. The bigger sigma value of Gaussian filter, the blurrier result of filter.

Method that is used in this study is Gaussian filtering method. This application is expected to be capable of running well in reducing noise.

Those are some earlier journals related to the topic and discussion is used as reference to develop this research.

Dessy Purwanti "The Implementation of Gaussian Smoothing Method Used as Image Smoothing". The weakness of this research is image format used is Bitmap (BMP) and JPG, and the output cannot be saved in the image processing 2[1].

Amril Mukmin Harahap "The Design and Implementation of Noise, Salt and Pepper Reduction Application Using Improved Median Filter Method". In this research, image calibration is only in one phase and there is no image quality calibration [2].

Andre Wedianto, "Analyzing The Comparison of Gaussian Filter, Mean, and Median toward Noise reduction". The weakness of this research is no image quality calibration in jpg format and image calibrated is only one [3].

Gilang Juanda "Designing Noise Reduction in Digital Image Using WAVALET Based Method". The weakness of this research is no image quality calibration [4].

Dini Sundani "Image Smoothing Application Based Classic and Quantum Computation". The weakness of this research is no image quality calibration and the image calibrated is only four in jpg format [5].

1.2 Problem

These are some problem will be investigated here.

- 1) Determining image data will be processed in image smoothing.
- 2) Implementing Gaussian filter and system in order to be an application used to reduce digital image noise.
- 3) Image used is an image originally affected by noise.

1.3 Objectives

These are some research objectives.

- 1) Creating image smoothing application to reduce noise using Gaussian filter.
- 2) Implementing system in order to be an application capable of processing image smoothing using Gaussian filter.
- 3) Calibrating original image using Gaussian filtering, including size, pixel, and image quality (RMSE, PSNR and SNR).

2. METHODOLOGY

The application production is conducted in some phases. The first phase is a plan. In this phase, it plans the basic concept of application and use of programming language. The second phase is designing application appearance which will be created. The next phase is a calibration. In this phase, the application will be tested.

2.1 Designing Application

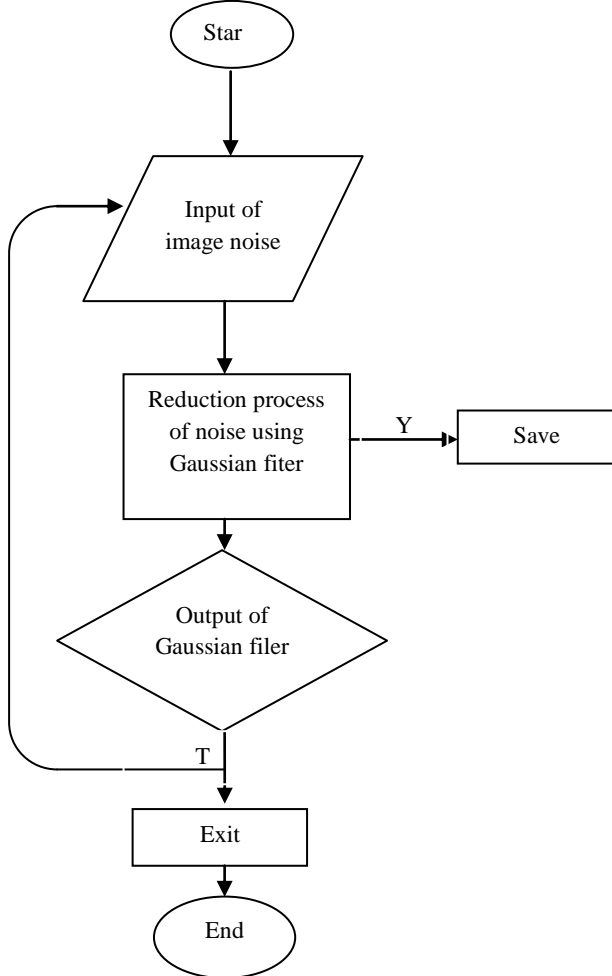


Fig. 1. Flowchart of Application Design

Design of image smoothing application starts from input of image noise. Then noise is reduced by Gaussian filter. From the output of Gaussian filtering, it is possible to save the picture of Gaussian filter output. If it is not done, it should be reprocessed or exit from the application.

2.2 Designing Appearance

Design of appearance is used to make an application in order to avoid obstacle in designing application interface which will be created. Design of this application consists of six buttons, namely choose image, grey noise, Gaussian filter, reprocess, save, and exit.

2.3 Phase

In calibration phase, the application will be tested by using ten different pictures and using a picture in PNG,BMP,JPG format. The output of Gaussian filter will be compared between the size and the original one. Then It will conduct image calibration by finding out the value of RMSE,PSNR and SNR which is in decibel (db).

3. RESULT AND DISCUSSION

3.1 Discussion

In this discussion, it will talk about application appearance and menu button used. Look at the picture below.

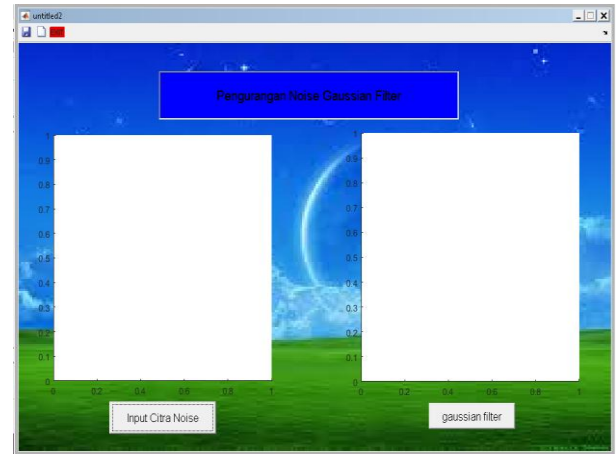


Fig. 2. Application Appearance

In the beginning appearance above, it consists of some menu buttons. For further information, look at the picture below.

1). Input of image noise



Fig. 3. Choose picture

Input of image noise is menu button to choose image affected by noise in jpg, bmp, and png format.

2). Gaussian Filter

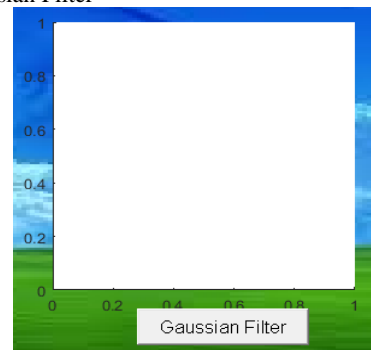


Fig. 4. Gaussian filter

Menu button of Gaussian filter is used to change an image affected by white grain noise become an better image which does not contain white grain noise by using Gaussian filter.

3). Save

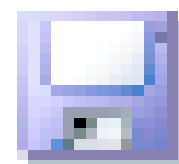


Fig. 5. Menu Button of Save

Menu button of save is used to save the output of Gaussian filtering which in jpg format.

4). Reprocess



Fig. 6. Menu button of Reprocess

It is used to reprocess image smoothing from input of image noise

5).Exit



Fig. 7. Menu Button of Exit

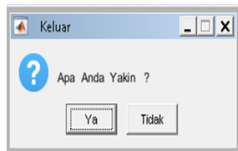


Fig. 8. Exit Notice

Menu button of exit is used to leave the application, if all is done. Before leaving the application, exit notice will appear.

3.2 Calibrating

This calibration is conducted by using ten images affected by noise and using an original image affected by noise captured long time ago.

Table 1. Image Noise

Image Name	Image Noise	Pixel	Size
Noise1.png		487×255	198 kb
Noise2.png		1000×750	1.21mb
Noise3.png		625×449	692kb
Noise4.bmp		562×346	570 kb
Noise5.bmp		700×500	1.00 mb







Noise6.bmp		400×270	316 kb
Noise7.jpg		677×355	48kb
Noise8.jpg		1024×656	552 kb
Noise9.jpg		630×937	188kb
Noise10.jpg		640×410	120 kb

From the table 1, it is known that all images have different noise, size, and format. Then the noise will be reduced by using Gaussian filter.

1).Calibrating Gaussian Filter

Table 2.Noise Reduction Using Gaussian Filter

Image Name	Output of Gaussian filter	Size	Pixel
Pengujian 1.jpg		24 kb	487×255
Pengujian 2.jpg		68.0 kb	1000×750
Pengujian 3.jpg		28.0 kb	625×449
Pengujian 4.jpg		20.0 kb	562×346

Pengujian 5.jpg		52.0 kb	700×500
Pengujian 6.jpg		16.0 kb	400×270
Pengujian 7.jpg		16.0 kb	677×355
Pengujian 8.jpg		48 kb	1024×656
Pengujian 9.jpg		84.0 kb	630×937
Pengujian 10.jpg		44.0 kb	640×410

From the process of noise reduction using Gaussian filter on the table 2, all images affected by noise which has different kind and size have succeed to reduce noise using Gaussian filter. The result of noise reduction process creates output of image which is different from before using Gaussian filter. The format changes to jpg and the result of noise reduction is blurrier than the original one. It is caused by effect of filtering and Gaussian. The image size of noise reduction using Gaussian filter is smaller than the original one and the pixel is the same as the original one.

3.3 Calibrating Image Quality

Root Mean Squared Error (RMSE) is used to measure error level of filtering result by comparing with the original one. The bigger value of RMSE is created, the bigger error level of filtering result is created. It makes the image created more different from the original one.

Peak Signal to Noise Ration (PSNR) is used to compare between maximum value of signal measured and the size of noise which affects that signal. PNSR is a standard parameter to evaluate image quality objectively by comparing PNSR. The bigger value of PSNR is created, the more similar image is created.

Signal to Noise Ration (SNR) is used to measure quality of signal. It is measured based on the original image and the image which is the result of filtering. The bigger value of SNR is created, the better signal is created.

Table 3. Image which is The Result of Noise Reduction

Image	RMSE	PSNR	SNR
Pengujian1.Jpg	1185.5739	17.3915	13.2861
Pengujian2.Jpg	19.2960	35.2761	30.9538
Pengujian3.Jpg	417.6772	21.9224	14.7823
Pengujian4.Jpg	851.3292	18.8298	15.2837
Pengujian5.Jpg	384.1080	22.2863	18.1196
Pengujian6.Jpg	212.7200	24.8527	20.2582
Pengujian7.Jpg	366.4931	22.4901	19.4497
Pengujian8.Jpg	214.6883	24.8127	20.4312
Pengujian9.Jpg	280.9278	23.6449	19.8898
Pengujian10.Jpg	1027.3495	18.0136	13.0657

From the table 3, it indicates that the biggest value of RMSE is in the pengujian1 jpg. It is caused by the result of noise reduction different from the original one which is affected by noise. The biggest PNSR is in the pengujian2.jpg. SNR is in pengujian 2 jpg. The smallest RMSE is in the pengujian 2 jpg. The PSNR and SNR are in pengujian 2 jpg. The result of noise reduction which is the most similar to the original one is in the pengujian 2 jpg. The value of RMSE is 1185.5739db, PSNR:17.3915db, SNR:13.2861db. The most similar to the original one is in the pengujian 2 jpg. The value of RMSE is 19.2960db, PSNR:35.2761db, SNR 30.9538db.

4. CONCLUSSION

Based on the result of Gaussian filtering process, there are some conclusions.

- 1) The process of image smoothing to reduce noise using Gaussian filter creates an image better than before doing noise reduction.
- 2) To disentangle noise using Gaussian filtering based on the result of image smoothing process succeed to disappear effect of noise using Gaussian filtering, but it creates an image blurrier than the original one. It is caused by effect of Gaussian filtering. The size of image is smaller than the original one.
- 3) The image formats which are possible to process using Gaussian filter are PNG, JPG, and BMP.
- 4) The result of noise reduction which is the most similar to the original one is in the pengujian 2 jpg which the value of RMSE is 1185.5739db, PSNR:17.3915db, SNR:13.2861db and the most different is in the pengujian 1 jpg which the value of RMSE is 19.2960, PSNR:35.2761, SNR 30.9538db
- 5) The image size using Gaussian filter is smaller than the original one.
- 6) The biggest value of RMSE is in the pengujian 1 JPG. It caused by the noise reduction different from the original one. The biggest PSNR is in the pengujian 2 JPG. The SNR is in the pengujian 2 JPG. The smallest RMSE is in the pengujian 2 JPG. The PSNR and SNR are in the pengujian 2 JPG.

5. ACKNOWLEDGMENTS

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