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# Color image enhancement using filtering and contrast enhancement

Budi Utami Fahnun[1], Lukman Safri Andani[2], Hadyan Mardhi Fadlillah[3], Hendri Dwi Putra[4]

[1,4]Computer Systems Department, Faculty of Computer Science and Information Technology Gunadarma University, Indonesia

[2,3]Informatics Engineering Departemen, Faculty Of Industrial Technology Gunadarma University, Indonesia

A R T I C L E I N F O

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ABSTRACT

Image is an efficient media for information and communication. Filtering on image enhancement is one of the processes in image processing to reduce noise in the image. This study uses the type of noise Salt & Pepper to be applied to flower images and scenic images that the author uses in this study as a comparison test of filtering methods. Filters used in testing and comparison are Median Filter, Mean Filter, and Gaussian Filter. This research also applies the Contrast Enhancement process to highlight certain aspects contained in the image. From the results of testing and comparison of filtering methods it can be concluded that the best method for handling Salt & Pepper noise is Median Filter, which has the best MSE value is 0.7329 to the worst MSE value is 26,766, the best RMSE value is 0.8561 to the worst RMSE value is 5.1736, and the best PSNR value is 49,513 to the worst PSNR value is 33,889 . This research concludes that it has succeeded in making an application of Image Enhancement and comparison Using Median Filter, Mean Filter, Gaussian Filter, And Contrast Enhancement using MATLAB 2016b which can reduce Salt & Pepper noise.



*Corresponding Author:*

Dr. Budi Utami Fahnun
[1]Computer Systems Department, Faculty of Computer Science and Information Technology Gunadarma University
Jl. Margonda Raya Number. 100, Depok 16424, West Java
Email: bufahnun@staff.gunadarma.ac.id

## 1. INTRODUCTION

Image is an efficient media for information and communication. The elements contained in the image play an important role in the human visual system, namely the means needed for the needs of human perception. According to research (Utama, 2011), humans have the ability to recognize certain objects from a collection of objects they see, because the human visual system consists of a combination of the process of recording and detecting objects.

Image processing is involving visual perception. According to research (Adler, 2018), the image processing has input and output data in the form of images. However, the image produced from image processing has better quality, compared to the original

image. For example, the color image is colorless, so that the image becomes difficult to interpret because the information contained is reduced. If something like that happens, it needs to be processed to improve the image quality.

To improve the quality of a digital image, there is a noise reduction technique that can be used. In noise reduction there are several methods that can be used, some of which are median filtering, mean filtering, and gaussian filtering. According to research (Oktafian, 2019), the Mean Filter is to replace the pixel value at the position (x, y) with the average value of the pixels that are in the surrounding neighbors. The larger the dimensions of the processed image, the longer the processing time. According to research (Wedianto, 2016), Median Filtering is a filter technique that sorts the intensity value of a group of pixels, then replaces the processed pixel value with its median value (the middle value). (Samad, 2013), using the Median filter method in his research to eliminate noise and also to preserve the details in the image, so that we can get a digital image with the smallest noise. According to research (Afifa, 2016), Gaussian filters are obtained from convolution operations. Multiplication between kernel matrix and original image matrix in convolution operation. The kernel is shifted along rows and columns in the image so that a new image is obtained, it is obtained at the convolution operation.

From previous studies (Samad, 2013), eliminating noise in digital images by using the median filter method. The study uses one sample image, then gives noise to the sample image. In this research, a median filter method is processed in an image that has been given noise so that it can be tested whether the noise will disappear if a median filter has been processed on a damaged image.

The urgency of this study is focused on image processing which involves visual perception. According to research (Adler, 2018), image processing has input and output data in the form of images. However, the resulting image from image processing has better quality than the original image. For example, a color image is colorless, so the image becomes difficult to interpret because the information contained is reduced. If something like that happens, it needs to be processed to improve the image quality.

Based on the above research, this study will create a GUI application to improve image quality by utilizing color, brightness, and noise reduction. Continuing from previous studies to get better results, because in previous studies only did noise reduction. In this system image processing is used which can transfer a color from one image to another. This system also increases and decreases the level of contrast with the aim of getting a better image. Like previous studies, this system also processed noise reduction using mean filters, median filters, and gaussian filters. After processing to get a better image, this system will compare the image that has been processed with the original image using the Mean Square Error (MSE), Root Mean Squared Error (RMSE), and Peak Signal-to-Noise Ratio (PSNR) method

## 2. RESEARCH METHOD

### 2.1 Input Noise

The process of giving noise is done to test several types of filtering methods, to see better results from the filtering method. Noise applied to the image is a type of noise in general, namely salt & pepper noise. An example of an image with noise can be seen in Figure 1.

(a) (b)

Figure 1. (a) Original Image (b) Noisy Image

## 2.2 Filtering

After the noise is given to the image, the next step is to improve the image quality by using the filtering method. The filters used in this study are the median filter, mean filter, gaussian filter and other than that, the author uses the method of color transfer, increase contrast, and decrease contrast in an effort to improve image quality. An image contaminated by noise can disrupt the quality of the image so that the image becomes difficult to interpret because the information contained is reduced. Therefore, an image quality improvement process is needed. The noise used to test the filtering method so that it can be compared with other filtering methods.

## 2.3 MEDIAN FILTER

Filling in the value of each pixel with the result of its neighbor's median value is a technique used in the median filter method. The process of selecting the median begins by first sorting the neighboring pixel values, then selecting the middle value can be seen in Figure 2.

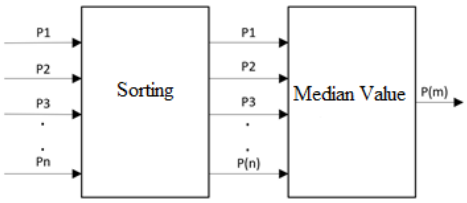


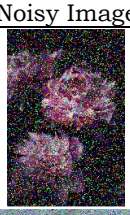
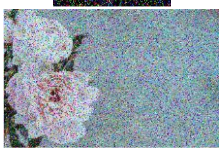
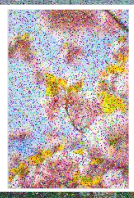
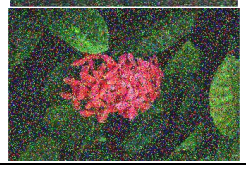

Figure 2. Median filter workflow diagram.
(Davies, 1990).

Median filter is a process of improving image quality by removing noise in the image.

## 2.4 Mean Filter

Mean Filter replaces the pixel value at position (x, y) with the average pixel value in its surrounding neighbors. Mean filter is the process of improving image quality by eliminating noise in the image. Table 1 will display some of the images produced using the mean fitler process.

Table 1. Mean Filtered Images

| Image Name | Original Image | Noisy Image | Mean Filtered Image |
|---|---|---|---|
| Flower11 |  |  |  |
| Flower12 |  |  |  |
| Flower13 |  |  |  |
| Flower14 |  |  |  |
| Flower15 |  |  |  |

2.5 Contrast Enhancement

Contrast enhancement is based on emphasizing differences in brightness in an image to improve its perceptual quality. However, there is no universal definition for contrast (Saleem, 2012).

$$\nabla \mathrm{I}\,(\mathrm{x},\mathrm{y}) = \begin{bmatrix} Gx \\ Gy \end{bmatrix} = \begin{bmatrix} \frac{\partial}{\partial \mathrm{x}} I(x,y) \\ \frac{\partial}{\partial \mathrm{y}} I(x,y) \end{bmatrix} \quad (1)$$

Where Gx and Gy at equation (1) are obtained from equation (2) and (3):

$$Gx = I\,x,y - I\,x+1,y \quad (2)$$

$$Gy = I\,x,y - I\,x,y+1 \quad (3)$$

Contrast enhancement is done to improve image quality. Contrast serves to highlight certain aspects of the image.

## 3. RESULTS AND DISCUSSIONS

At the implementation stage of the image quality test, the image will be tested and compared with quantitative values, namely MSE, RMSE, and PSNR to be able to see the best filtering method in improving image quality. MSE and RMSE do not have a unit of value, but PSNR has a unit of value, namely dB or desible. The more MSE and RMSE values in the image are closer to zero, the image is said to have good image quality, whereas if the PSNR value is more than 30 dB, the better the image similarity level.

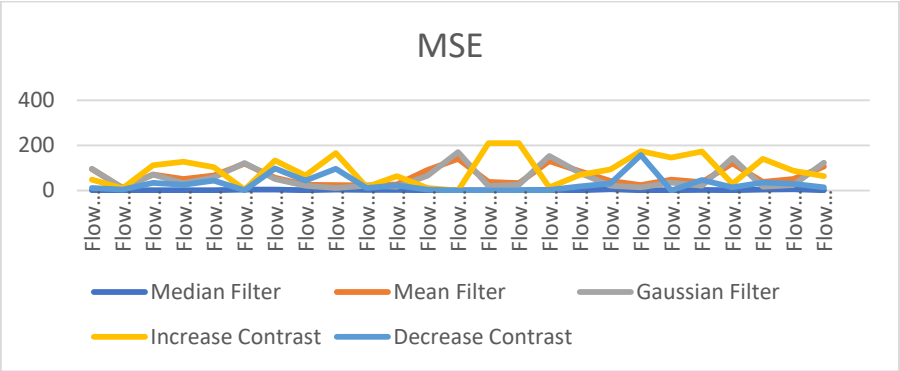



Figure 3. Flower images quality test based on MSE value

Figure 3 below will display the results of the filtering flower images quality test based on the MSE value. It can be seen in Figure 3 that the median filter has the best MSE value on flower images, because it has an average value close to zero.

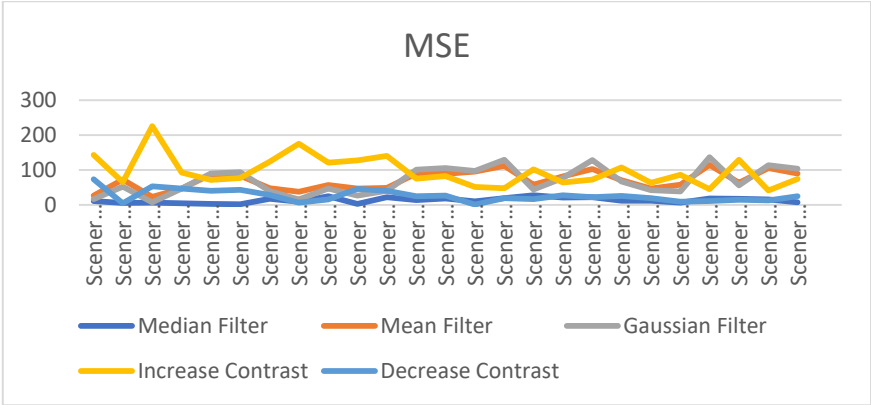



Figure 4. Scenery images quality test based on MSE value

Figure 4 below will display the results of the filtering scenery images quality test based on the MSE value. It can be seen in Figure 4 that the median filter has the best MSE value on flower images, because it has an average value close to zero.

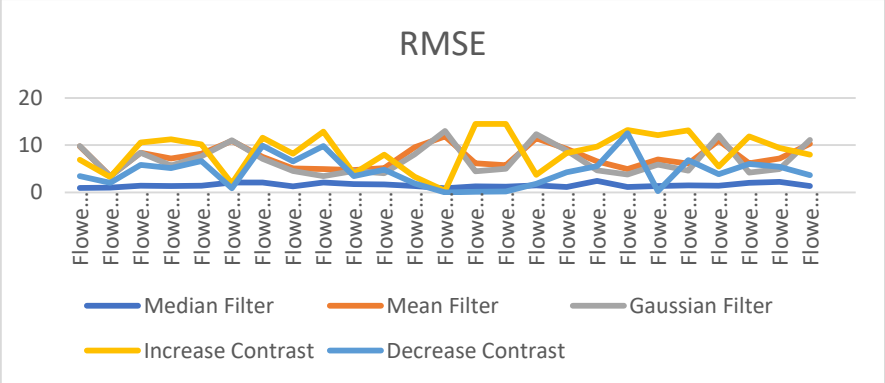



Figure 5. Flower images quality test based on RMSE value

Figure 5 show the results of the filtering flower images quality test based on the RMSE value. Figure 5 show that the median filter has the best RMSE value on flower images, because it has an average value close to zero

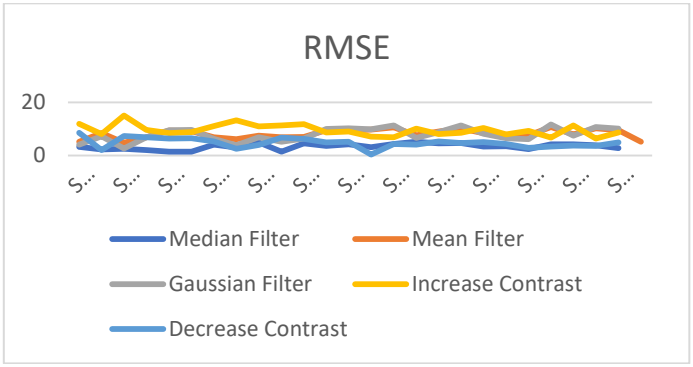



Figure 6. Scenery images quality test based on RMSE value

Figure 6 show the results of the filtering scenery images quality test based on the RMSE value. Figure 6 show that the median filter has the best RMSE value on flower images, because it has an average value close to zero

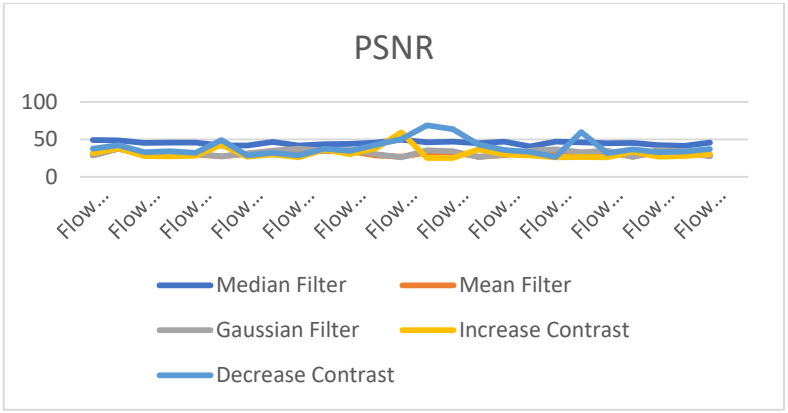



Figure 7. Flower images quality test based on PSNR value

Figure 7 show the results of the filtering flower images quality test based on the PSNR value. Figure 7 show that the median filter has the best PSNR value on flower images, because it has an average value greater than 30.

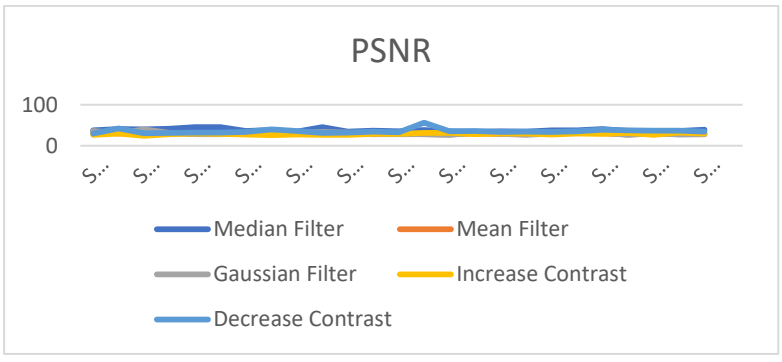



Figure 8. Scenery images quality test based on PSNR value

Figure 8 show results of the filtering flower images quality test based on the PSNR value. Figure 8 show that the median filter has the best PSNR value on flower images, because it has an average value greater than 30

## 4. CONCLUSION

Based on the implementation and trials that have been carried out, the author has succeeded in creating an image processing GUI application named "Image Enhancement Using Median Filters, Average Filters, Gaussian Filters, and Contrast Enhancement" using MATLAB 2016b. This research contributes to reducing Salt & Pepper noise by using the Median Filter, Mean Filter, and Gaussian Filter methods. The best method for handling Salt & Pepper noise is the Median Filter which has the best MSE value of 0.7329 to the worst MSE value of 26.766, the best RMSE value of 0.8561 to the worst RMSE value of 5.1736, and the best PSNR value of 49.513 to the worst PSNR value is 33,889. The larger the pixel size in an image, the longer the application will process the image. This research has limitations in testing only using salt & pepper noise, this research can be developed with other types of noise for image enhancement

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