

# Improved Digital Image Quality Using the Gaussian Filter Method

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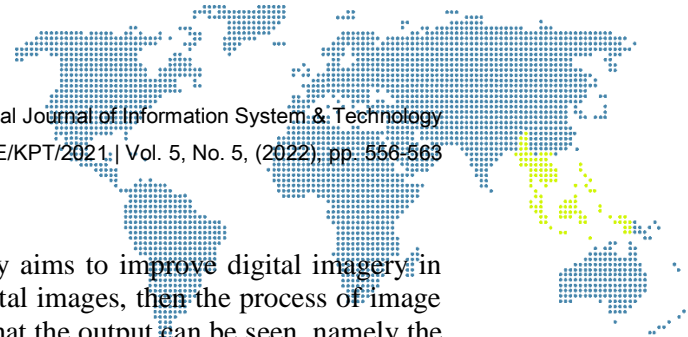
## Abstract

Digital imagery from digital image cameras often has some disturbances that may occur, such as lenses not focusing, spots appear caused by the imperfect capture process. This ineptness can be caused by uneven lighting resulting in uneven intensity, low image contrast and the appearance of noise in the image. Of course all these negative effects will reduce the quality on digital imagery. To overcome the noise, efforts need to be made to improve the quality of that image. One of them is by filtering the image both linearly and non-linearly. There are many methods that can be used to perform linear and non-linear filtering. Images that contain noise can limit the valuable information needed when image analysis is done. Gaussian filter is one of the linear filters that serves to smooth and eliminate noise in an image. Mean Filter is very simple and easy to implement and is very useful for reducing the variation in value of a pixel with the next pixel. This filter works by replacing the intensity of the pixel value with the average the neighboring pixels.

**Keyword:** Citra, Noise, Gaussian Filter

## 1. Introduction

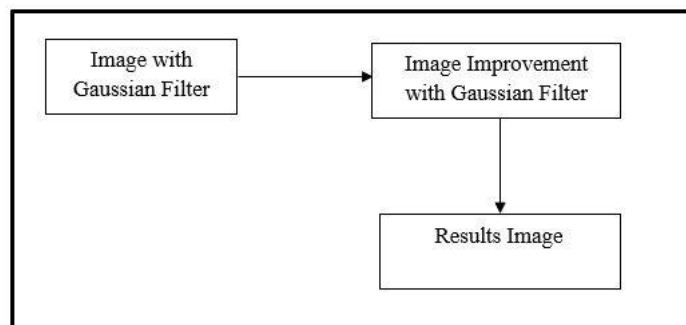
Digital imagery from digital image cameras often has some disturbances that may occur, such as lenses not focusing, spots appear caused by the imperfect capture process. These imperfections can result from uneven lighting resulting in uneven intensity, too low image contrast and noise in the image. Of course all these negative effects will reduce the quality on digital imagery. To overcome the noise, efforts need to be made to improve the quality of that image. One of them is by filtering the image both linearly and non-linearly. There are many methods that can be used to perform linear and non-linear filtering. Images that contain noise can limit the valuable information needed when image analysis is done. This causes noise to be eliminated so that the results obtained become optimal [1]. To overcome the noise in the image needs to be made efforts to improve the quality of the image, one of which is by filtering the image. There are many image filtering techniques, and in this study the authors used spatial domain filtering techniques. A spatial domain is a filtering technique based on manipulating a pixel set of an image to generate a new image [2]. In the spatial domain there are types of filters, namely, nonlinear filters and linear filters [3]. In this study the authors used a linear filter that is the mean filter. Mean filter serves to smooth and eliminate noise that operates by replacing the values that are at the midpoint of the entire matrix in the image with the average value on the damaged image [4]. Gaussian filter is one of the linear filters that serves to smooth and eliminate noise in an image. Mean Filter is very simple and easy to implement and is very useful for reducing the variation in value of a pixel with the next pixel. This filter works by replacing the intensity of the pixel value with the average of the pixel value of the pixel value with the average of the pixel value with the value of the neighboring pixels.



## 2. Research Methodology

Based on the planning diagram above, this study aims to improve digital imagery in color images. The first step is done by inputting digital images, then the process of image improvement using the Gaussian Filter method, so that the output can be seen, namely the image of the improvement with the Gaussian Filter method. In this study the data collection techniques used are as follows:

- a) Literature Studies, data collection techniques are conducted by looking for information and knowledge sourced from books, scientific journals and other sources related to research, especially about image improvement with gaussian filter methods.
- b) Observation is a technique of collecting data by directly observing an object to find information and knowledge related to research.



**Figure 1.** Image improvement planning diagram with Gaussian Filter Method

## 3. Result and Discussion

### 3.1. Problem Analysis

To be able to apply the Gaussian Filter method, first a digital image representation is carried out in the form of a matrix with pixel value elements, then calculations are performed for the formation of gaussian filters based on pixel values in the image. The final stage for improvement is to conduct the process of convolution of Gaussian filters to digital images.

### 3.2. Algorithmic Analysis

To analyze the algorithm used, it will be done by creating a sample image as follows:

- a) A grayscale image measuring 8x8 pixels is presented in matrix form as below:

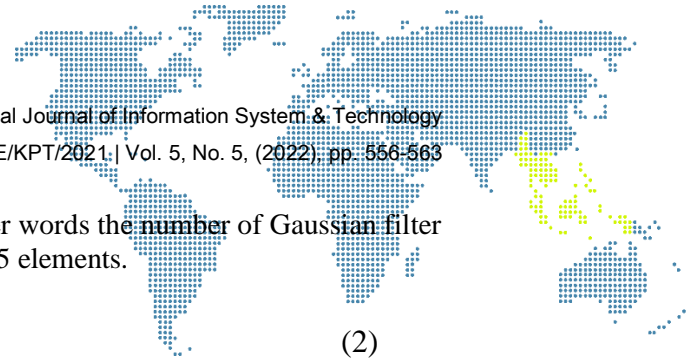
60	200	200	85	162	162	162	136
252	252	252	89	89	249	122	122
26	26	210	77	77	149	5	67
172	172	172	205	205	73	230	230
47	232	232	181	181	181	181	181
108	108	108	108	55	223	28	28
221	221	60	60	91	91	156	156
197	5	5	5	204	62	62	134

**Figure 2.** Image Sample 8 x 8

- b) Gaussian Filter Formation

To improve the digital image, gaussian filters will be performed using the following equations:

$$G(x, y) = \frac{1}{2\pi\sigma^2} \exp(-(x^2 + y^2)/2\sigma^2) \quad (1)$$



Gaussian filter to be formed is 5×5 pixels, in other words the number of Gaussian filter matrix elements that will be formed as many as 25 elements.

Calculation 1 at coordinates (0,0):

$$G(x, y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(x^2+y^2)}{2\sigma^2}\right) \quad (2)$$

$$G(0,0) = \frac{1}{\sqrt{(2).(3,14).(1)^2}} \exp\left(-\frac{(0^2+0^2)}{2(1)^2}\right)$$

$$G(0,0) = 0,1592$$

For the full calculation results will be presented in the form of Gaussian filters as below:

0.0029	0.0131	0.0215	0.0131	0.0029
0.0131	0.0585	0.0965	0.0585	0.0131
0.0215	0.0965	<b>0.1592</b>	0.0965	0.0215
0.0131	0.0585	0.0965	0.0585	0.0131
0.0029	0.0131	0.0215	0.0131	0.0029

**Figure 3.** Image of formation with Gaussian Filter

c) Convolution Process

After obtaining a Gaussian filter, the next stage is the process of improving the image by convolution using gaussian filters that have been obtained before digital images.

Calculation 1  $f(3,3)$ :

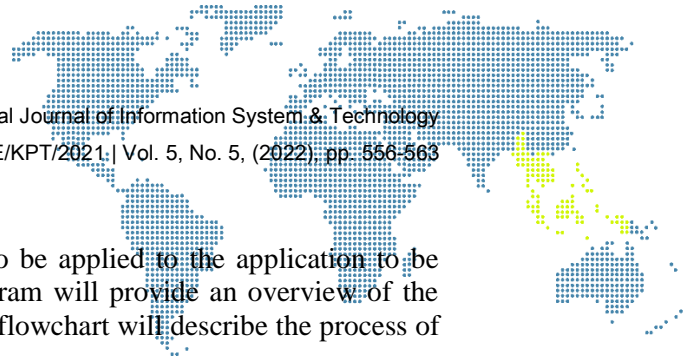
$$\begin{aligned} f(3,3) = & (0,0029 \times 60) + (0,0131 \times 200) + (0,0215 \times 200) \\ & + (0,0131 \times 85) + (0,0029 \times 162) + (0,0131 \times 252) \\ & + (0,0585 \times 252) + (0,0965 \times 252) + (0,0585 \times 89) \\ & + (0,0131 \times 89) + (0,0215 \times 26) + (0,0965 \times 26) \\ & + (0,1592 \times 210) + (0,0965 \times 77) + (0,0215 \times 77) \\ & + (0,0131 \times 172) + (0,0585 \times 172) + (0,0965 \times 172) \\ & + (0,0585 \times 205) + (0,0131 \times 205) + (0,0029 \times 47) \\ & + (0,0131 \times 232) + (0,0215 \times 232) + (0,0131 \times 181) \\ & + (0,0029 \times 181) \end{aligned}$$

$$\begin{aligned} f(3,3) = & 0.174 + 2.62 + 4.3 + 1.1135 + 0.4698 + 3.3012 + 14.742 + 24.318 \\ & + 5.2065 + 1.1659 + 0.559 + 2.509 + 33.432 + 7.4305 \\ & + 1.6555 + 2.2532 + 10.062 + 16.598 + 11.9925 + 2.6855 \\ & + 0.1363 + 3.0392 + 4.988 + 2.3711 + 0.5249 \end{aligned}$$

$$f(3,3) = 157.6476 = 158$$

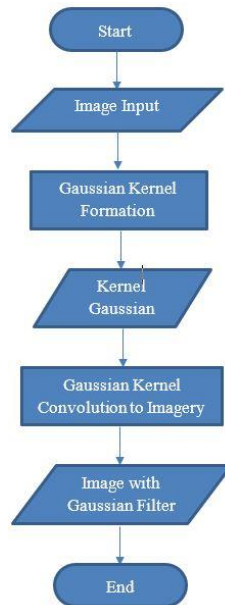
60	200	200	85	162	162	162	136
252	252	252	89	89	249	122	122
26	26	<b>158</b>	<b>142</b>	<b>131</b>	<b>130</b>	5	67
172	172	<b>166</b>	<b>161</b>	<b>149</b>	<b>142</b>	230	230
47	232	<b>163</b>	<b>157</b>	<b>150</b>	<b>148</b>	181	181
108	108	<b>129</b>	<b>119</b>	<b>123</b>	<b>130</b>	28	28
221	221	60	60	91	91	156	156
197	5	5	5	204	62	62	134

**Figure 4.** Convolution Results Image with Gaussian Filter



### 3.3. Flowchart Program

To describe the flow of data on the algorithm to be applied to the application to be built, a diagram is used called flowchart. This diagram will provide an overview of the data flow of each input, process, and output. In this flowchart will describe the process of image repair using gaussian filters as follows:

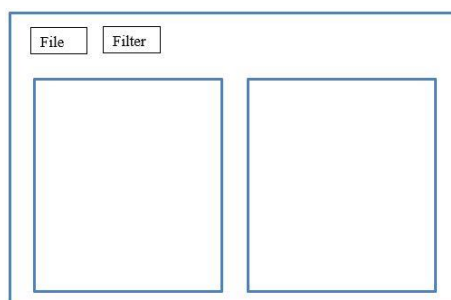


**Figure 5.** Flowchart Image Improvement Using Gaussian Filter

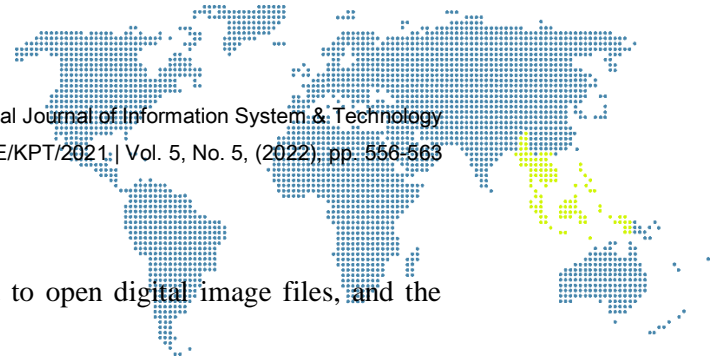
To filter the image, the user is asked to select an image to be processed. Where the convolution process will be carried out on each pixel in the image using the Gaussian kernel, after the application has finished filtering all pixels of the image in the process, the application displays the results of the image repair process.

### 3.4. System Planning

In the design phase of this system will discuss about the design interface of the system to be built. In the system to be built this only has 1 (one) interface. The results of this design will be applied to the Microsoft Visual Basic 2010 programming language. The following will be presented the design of the user interface that will be used in the system to be built. There is only 1 (one) interface to be designed, namely the Main interface where this single interface is considered capable of presenting input, process, and output interactions. In this main interface there are 3 (three) buttons, namely the OK button, SAVE and exit button. In addition to buttons, the main interface is also equipped with 2 (two) PictureBox that serves to display input imagery and output imagery. The image below is a design interface for the system to be built.



**Figure 6.** Main Interface Design

**Information:**

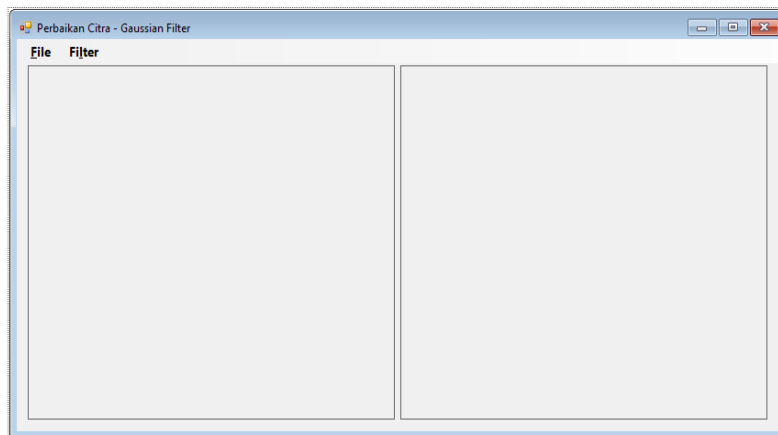
1. File Menu  
The File menu consists of the Open menu used to open digital image files, and the Save menu to save repaired image files.
2. Filter Menu  
Filter menu used to perform digital image improvements using gaussian filter method
3. Picture Box 1  
Picture Box 1 is used to display input images or images to be processed.
4. Picture Box 2  
Picture Box 2 is used to display filtered images.

**3.5. Test Results**

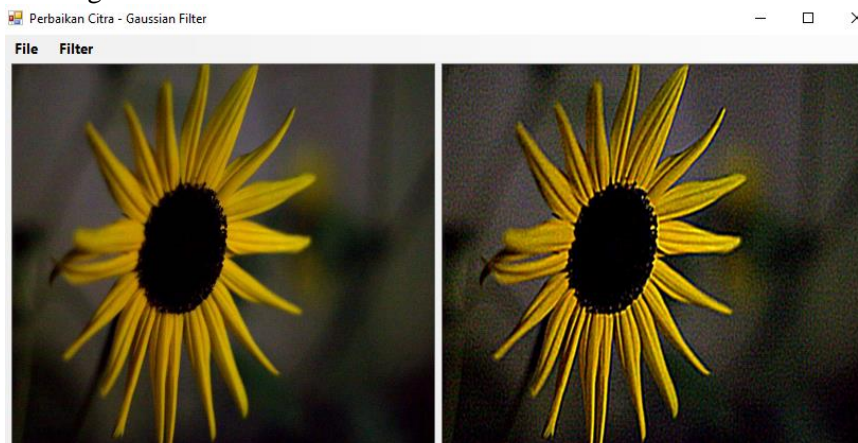
Based on existing digital image data, the process of testing the image object will be carried out. At this stage, testing will be tested on color image objects. The testing process of each image can be seen in the following image:

**a) Interface Implementation**

Gaussian Filter application is equipped with a graphical interface that aims to facilitate users in their use. The function of this interface is to provide input and display the output of the application. This application only has one (one) interface. Where input and output are presented on the same form.

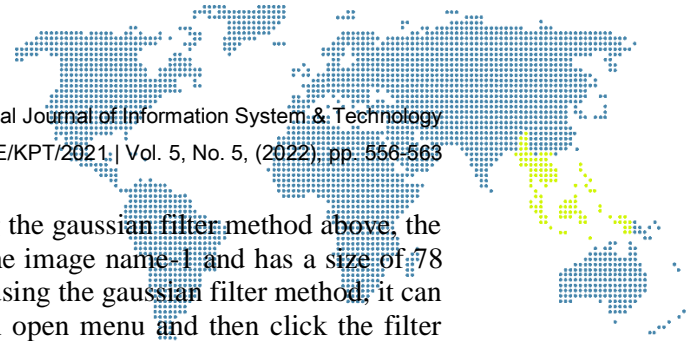


**Figure 7.** Image Improvement Application Interface With Gaussian Filter

**b) Form Testing of Digital Image Repair System Using Gaussian Filter Method****1) Citra Testing-1**

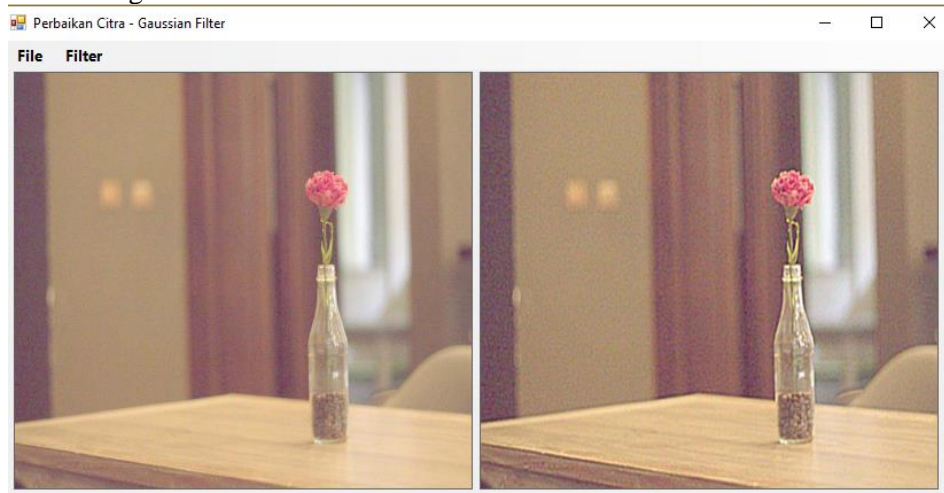
**Figure 8.** Digital Image Repair Process Using Gaussian Filter Method in Citra-1





In the process of improving digital imagery using the gaussian filter method above, the image inputted is an image with JPG format with the image name-1 and has a size of 78 kb. To do the process of improving digital imagery using the gaussian filter method, it can be done clicking on the file button then there is an open menu and then click the filter button and then click the gaussian menu. After that the image of the repaired with the gaussian filter method can be saved by clicking back the file button, then click the save menu, after which it will appear a menu to save the image of the results that have been improved with the gaussian filter method.

## 2) Citra Testing-2



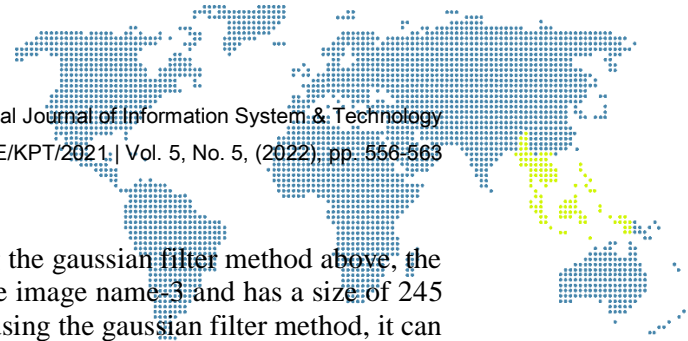
**Figure 9.** Digital Image Repair Process Using Gaussian Filter Method in Citra-2

In the process of improving digital imagery using the gaussian filter method above, the image inputted is an image with JPG format with the image name-2 and has a size of 82 kb. To do the process of improving digital imagery using the gaussian filter method, it can be done clicking on the file button then there is an open menu and then click the filter button and then click the gaussian menu. After that the image of the repaired with the gaussian filter method can be saved by clicking back the file button, then click the save menu, after which it will appear a menu to save the image of the results that have been improved with the gaussian filter method.

## 3) Citra Testing-3





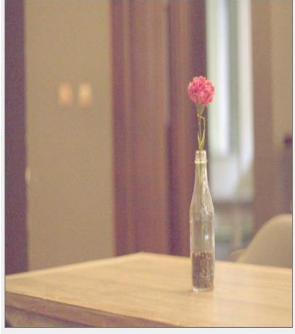



**Figure 10.** Digital Image Repair Process Using Gaussian Filter Method in Citra-3



In the process of improving digital imagery using the gaussian filter method above, the image inputted is an image with JPG format with the image name-3 and has a size of 245 kb. To do the process of improving digital imagery using the gaussian filter method, it can be done clicking on the file button then there is an open menu and then click the filter button and then click the gaussian menu. After that the image of the repaired with the gaussian filter method can be saved by clicking back the file button, then click the save menu, after which it will appear a menu to save the image of the results that have been improved with the gaussian filter method.

### 3.6. System Test Results Against Each Digital Image With Gaussian Filter Method

**Table 1.** Image Testing Results With Gaussian Filter Method

File Name and Size	Original Image	Repair Results Image	Results Image Size
Citra-1 78 kb			96 kb
Citra-2 82 kb			82 kb
Citra-3 245 kb			310 kb

## 4. Conclusion

Based on the results of previous tests and evaluations, Gaussian Filter method can be used to improve image quality. The performance time of the application improved image quality by using gaussian filter method that has been designed depending on the large dimensions of the image processed. The larger the dimensions of the image, the slower the repair process, and vice versa. The use of image quality improvement applications using the Gaussian Filter method can only be used on windows platforms. The result of



the process of digital image improvement using gaussian filter method results in an image that is larger than the size of the original image.

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