

Improving the Quality of Digital Images Using the Median Filter Technique to Reduce Noise

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Abstract— The combination of point, line, shape and color elements combined to create a physical imitation of an object is called an image. The arrangement of the box elements in the image forms pixels or matrices. Each image experiences degradation or loss of quality called noise. The effect of gaussian noise is the number of colored dots that are equal to the percentage of noise. This study raises the topic of improving the quality of digital images using median filter techniques to reduce noise. In this study using color image data (Red Green Blue) as test data and then converted into grayscale images to determine the gray degree of the image. The grayscale image is stored in the database. Then noise is generated by using random numbers. Noise in the form of impulse can be positive or negative in the form of adding pixel values to the original image, or it can reduce the value of the original image. The noise type used is salt & pepper. Gray degrees 0-255 spread. Can be calculated through image histograms. To reduce noise the median filter technique is used. Image histogram as a measure of the spread of numbers from the median filter. The result is a median filter can reduce noise salt and pepper by using a matrix kernel.

Keywords— RGB; Grayscale; Image Repair; Salt & Pepper Noise; Median Filter

I. INTRODUCTION

The matrix consists of an array of row and column numbers. Digital imagery states the point in the image and its matrix elements, called pixels. Each pixel has a color expressed in RGB, a combination of R values, G values and B values that cannot be separated from one another. The index histogram directly implements the 3-dimensional RGB color format. The gray intensity of the digital image is represented by the degree of gray (Singha R. J. 2015). Image retrieval techniques and image storage media affect image quality. In image processing, arithmetic operations and geometry operations aim to improve image quality. Addition and reduction of effects on the image are influenced by the usefulness of the image. Interference when shooting that might occur, such as a camera out of focus or the appearance of spots that could be caused by an imperfect capture process (Sinaga A. S, 2019). Any disturbance to the image is called noise. Noise in the image not only occurs due to imperfections in the capture process, but can also be caused by impurities that occur in the image. Images that experience a reduction or decrease

in image quality in the science of image processing are usually referred to as noise. Noise on digital images can occur due to many factors, such as lack of lighting or wrong settings when shooting, limited pixel resolution of the camera used and also limited ability to capture moving images due to limited memory and buffering, electromagnetic wave interference in image equipment, color which is incompatible blurred or even obsolete (Kaur, 2013). To provide a noise effect, a clean image is subject to noise by modifying each pixel in the image through a mathematical operation. Restore pixels using certain filters. Image enhancement techniques are used to improve the quality of a digital image, both in order to accentuate certain features in the image, as well as to improve aspects of the appearance (Pardosi, 2016). This process is usually based on procedures that are experimental, subjective, and very dependent on the objectives to be achieved. Input in this process is a digital image that is colored and then converted into grayscale images and then generated by Salt & pepper noise through random numbers after it is done generating 255 numbers (white). Noise (interference) in the image does not only occur because of

imperfections in the process of taking pictures or during the transmission process. But also because of the impurities that occur in an image. The initial filtering process is used to reduce the parts that are not needed noise in the image for the next process. The median filter works by replacing the middle value of the pixels covered by the median filter area after being sorted from the smallest to the largest forming salt sprinkles when the noise point is white and forming pepper when the noise point is black (Sinaga A. S, 2018). The size of the filter is odd because it will provide a central axis, so it will be easier to process images. The Image Enhancement (IE) technique is very useful in applications where an image with better differentiated texture details and better gushed perceptual colors. Image enhancement is a very important part of processing low-level images. The aim is to improve the quality of images that have low contrast values, to increase the difference in intensity between objects and background images and increase the interpretability or perceived information contained in the image. Image improvement is one of the simplest and most interesting methods in digital image processing. Salt and Pepper Noise Removal with Spatial Median Filter and Adaptive Noise Reduction, the testing process obtained by Spatial Median Filter percentage of noise > 20% produces an image of noise reduction results that have better quality than the Adaptive method Noise Reduction. Adaptive Noise Reduction method, the percentage of noise < 10% produces a better image of noise reduction compared to the Spatial Median Filter method (Shukla. K, 2017). The user enters an image that will be filtered. This image consists of a color image consisting of a square. If the image input is not a square image, then pixel capture will be performed on the image input.

II. LITERATURE REVIEW

A. Image Processing

The elements of the matrix above are called image elements, picture elements, pixels or mops. A pixel has two properties, namely the coordinates or position of the pixel and the value of that pixel. So an ordinary pixel is expressed as a two-dimensional function $f(x, y)$ (Sinaga, A. S. RM, 2018). For example a pixel $f(0,2) = 7$, means that the pixel is in row 0 and column 2, with a brightness intensity value = 7. In the digitizing process, M, N and L values (gray level allowed for each pixel) need to be determined. M and N values are free but are positive integers. Considering the use of hardware for processing, storage and sampling, the number of gray levels is 2 rank integers. This means that the level value of the image element (pixels) has a range between (Sinaga,

Anita Sindar RM, 2018).. For example, an image that has a gray level $L = 8$, means the gray intensity value of each pixel has a range between 0-7. The number of bits needed to store an image is $b = M \times N \times k$. Where M = number of image lines, N = number of image columns and k = number of bits needed to express a gray value. According to Purba in his journal (Volume VI No. 2, December 2017), image processing that can be done by computers consists of several types. Image quality improvement is one area that is quite popular. The application of image enhancement can improve the quality of images that are originally blurred or not in accordance with the wishes of the owner for the better.

B. Median Filter

The median filter is one of the most widely used non-linear digital filtering technique. This filter replaces the noise candidate pixels with median value of selected window 3×3 , 5×5 7×7 . Window size and window type is very much important as it affects edge preservation and blurring (Das. J, 2016). Under some circumstances it preserves the edge along with noise filtering. Through this degree of gray can be done various methods for image processing such as Low-Pass Filter and Median Filter. To make the image brighter or darker, changing the brightness of the image is performed. The brightness / brightness of the image can be improved by adding (or subtracting) a constant to (or from) each pixel in the image. As a result of this operation, the gray level of the image has shifted. Image enhancement is the process of image enhancement so that the image display is better in accordance with needs. In the median filter a window or layer that contains a number odd pixels are shifted point by point in the entire image area. At each shift a new window is created, the midpoint and this window are changed by the median value of the window. If a window is placed in an image plane, the pixel value at the center of the window plane can be calculated by finding the median value of the intensity value of a group of pixels sorted. The color feature is one of the most widely used visual features in image retrieval. The color of an image is represented through some color model. We have chosen RGB as colorimetric space (Das L, 2015). Typical characterization of color composition is done by color histograms. The aim of improvement is to process the image so that the results are more suitable than the original image to use data used to calculate the median consisting of odd data sets. This is due to the odd amount of data, the pixels to be processed can be in the middle of the concept of the Median (Xu. G. Lin. Y, 2016). Filter is to find the pixel value that has an intensity value of a pixel that is different from the pixel value in the surrounding area, and replace it

with the first line. extracts processed into grayscale or gray images so that only 1 intensity matrix is obtained. Secondly, prepare a ZERO matrix whose size is exactly the same as the image to be processed.

C. Noise

Effects such as the appearance of salt and pepper on an RGB image are called noise salt & pepper. It comes in three colors red, blue, green, while the grayscale image will appear in two colors black and white. This noise gives the effect "on and off" on the pixel. Pixel images with bipolar (black and white) impulse noise are degraded at $P(z)$. If $b > a$, the intensity of b will appear as the open point of light in the image. In contrast, level a will appear as a dark dot on the image. If P_a or P_b is zero, impulse noise is called unipolar (Weiying, 2015). If not possible the probability is zero, especially if the two are more or less balanced, the impulse noise value will form a random sprinkling of salt and pepper distributed in the image. Noise in the form of impulse can be of positive or negative value, meaning in the form of adding pixel values to the original image, or can reduce the value of the original image. Scaling as part of the image digitization process is used, because usually the corrupted image can be greater than the maximum pixel value or smaller than the minimum pixel value (outside the gray 0-255 degree range) (Sharma A, 2015). Impulse noise is digitized with extreme values like very black (0 in gray degrees) or very white (255 in degrees).

III. PROPOSED METHOD

Input image ($f(x, y)$), convert the RGB image to a grayscale image ($g(x, y)$). Data set is taken from 1 photo, an RGB image with an identity that is owned and displayed. RGB-Grayscale conversion. Citral pixel values are displayed using the MATLAB program. starting from the y axis as far as 124 and the x axis as far as 135, with their RGB (Red, Green, Blue) values [218, 165, 134]. The stages of research Figure 1.

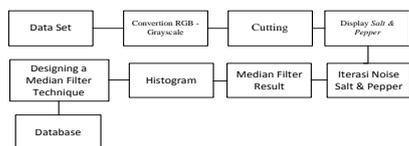


Figure 1. Research Stages

Image cutting is done to get the research area with a view to being able to do data processing that is more focused, detailed and optimized with expectations produce a representative and continuous image. Image cutting has another utility value, which is to reduce the area to be studied according to the area of

interest. Each x and y is taken as many as 10 pixels. So that for y starts from 124 to 133, and for x starts from 135 to 144. In the RGB image or color image, it consists of Red, Green, and Blue components and each component has a matrix value. The histogram calculation algorithm has an input having 256 gray degrees whose values are from 0 to 255. The pixel intensity is stored in Image $[0..N-1] [0..M-1]$, while the histogram is stored in the Hist table $[0 \dots 255]$.

Generating Salt and Pepper noise by giving Salt and Pepper noise $n(x, y)$ to $g(x, y)$ $g(x, y) = f(x, y) + v * \text{randn}(\text{size}(f(x, y)))$ Randn: Noise of Salt and Pepper states that the matrix with random data uses the normal distribution and the results of the calculation are stored in $g(x, y)$ Decomposes the image with Salt and Pepper noise with the mean method, displays the image that has been reduced by the method noise mean into axes. To reduce or change the noise of images affected by salt & pepper noise models use the Median Filter, then look for the middle value of a collection of numbers using iterations.

The results of the iteration are stored in a database. Salt and Pepper Noise takes the form of disturbances seen in black and white dots on images such as scattered salt and pepper. matrix which is generally small in size with elements in the form of numbers. The kernel is used in the convolution process. Kernel sizes vary, such as 2×2 , 3×3 , 5×5 , 7×7 and so on. The kernel-weighted elements form numbers that form certain patterns.

IV. RESULT AND DISCUSSION

The results of the median value from the data set are used to calculate the median consisting of odd data sets. At the median filtering the $N \times N$ dimension matrix is used which is sorted and entered in a $1 \times (N \times N)$ matrix. Noise reduction or denoise is a process to reduce or reduce noise in a digital image in improving image quality. The median filter algorithm is useful for repairing digital image pixels from interference with Salt & Pepper Noise. Example of the median filter matrix 3×3 :

5	3	3
2	6	3
2	1	9

Figure 2. Matrix 3×3

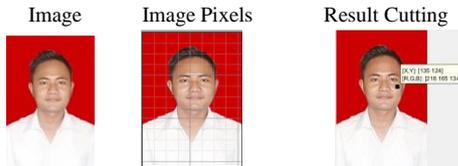
The results of the median filter matrix 3×3 , namely matrix 1 row 9 column:

5	2	2	9	3	3	3	6	1
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Figure 3. Matrix 1 x 9

If it is known that a matrix has 3 x 3 dimensions containing the main pixels and the surrounding pixels. The new pixel value then the median value is $x = 6$. This value of 6 will replace the value of 3. Test data consists of JPEG color images, Size 200x300 24 Bit, True Color color type. RGB (Red, Green, Blue)

TABLE 1. DATA SET



An RGB image can be converted into a Grayscale image by calculating the average color elements of Red, Green, Blue. The calculation is systematically as follows:

$$f_0 = (x, y) = \frac{f_i^R(x, y) + f_i^G(x, y) + f_i^B(x, y)}{3}$$

TABLE 2. RGB-GRAYSCALE



Salt and pepper noise usually looks like dots reduce image quality. Filters are used to eliminate image defects. Reducing noise so that the resulting image matches the original. To generate Salt & Pepper Noise, the pixel data in the grayscale table is changed to a number of 0 and 255 numbers are highlighted in yellow as below. The number 0 indicates salt and the number 255 indicates pepper. The matrix used to generate noise reduction, Table 3.

TABLE 3. MATRIX IMAGE RESULT

172	174	168	166	157	157	166	160	150	151
170	0	175	54	159	156	159	157	152	255
170	172	178	170	164	160	156	0	150	146
176	174	176	172	0	166	158	149	147	148
183	177	175	175	173	170	255	146	143	153
184	183	0	176	171	168	165	154	143	255
255	186	186	177	170	166	163	154	145	140
183	184	184	178	255	164	159	0	144	141
183	182	178	176	172	54	156	148	142	141
187	182	177	177	175	172	156	150	142	138

Based on point 4 given 10 points it becomes a value of 10% density or equal to 0.1. The higher the density, the more noise there is. The giving of numbers 0 and 255 is done randomly, Table 4.

TABLE 4. ADDITION IMAGE NOISE RESULTS



Median filter looks for the middle value of a collection of numbers using iteration. Next is the median filter with a size of 5 x 5, Table 5.

TABLE 5. MEDIAN FILTERS OF 5 X 5

172	174	168	166	157	157	166	160	150	151
170	0	175	54	159	156	159	157	152	255
170	172	178	170	164	160	156	0	150	146
176	174	176	172	0	166	158	149	147	148
183	177	175	175	173	170	255	146	143	153
184	183	0	176	171	168	165	154	143	255
255	186	186	177	170	166	163	154	145	140
183	184	184	178	255	164	159	0	144	141
183	182	178	176	172	54	156	148	142	141
187	182	177	177	175	172	156	150	142	138

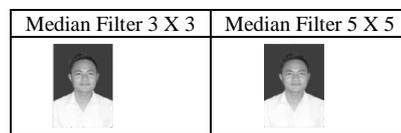
Iteration is taken from pixel data, table 6 with a size of 5 x 5 because it uses a median of size 5 x 5 marked with a yellow shading, Table 6.

TABLE 6. MEDIAN RESULT OF FILTERS OF 5 X 5

172	174	168	166	157	157	166	160	150	151
170	0	175	54	159	156	159	157	152	255
170	172	172	170	166	159	157	156	150	146
176	174	173	171	168	160	157	156	147	148
183	177	175	172	170	166	158	154	143	153
184	183	177	175	171	166	159	154	143	255
255	186	178	176	172	168	159	153	145	140

The image numbers located on the top, bottom, left and right edges are not changed because the median filter principle works to change the middle data not the edge data, Table 7.

TABLE 7. FILTER IMAGE PIXELS RESULTS



The results of the 5 x 5 median filter were changed into a histogram, Table 8.

TABLE 8. HISTOGRAM RESULT

172	170	166	159	157	156
173	171	168	160	157	156
175	172	170	166	158	154
177	175	171	166	159	154
178	176	172	168	159	153
182	177	172	166	156	150

To make a histogram curve, it is made into a frequency table for each color pixel in the image (x).

The smallest to the largest sorting process is performed. With a value of N = 36 (pixel data).

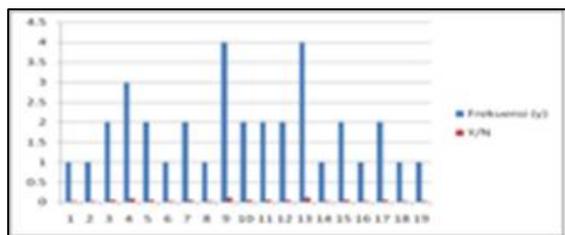


Figure 4. Diagram Histogram

The results of the Implementation of Novelty on the image developed in the image improvement application. Image conversion menu used to extract RGB images, the results of RGB values for reference to gray scale, Figure 5.



Figure 5. Conversion Form

The grayscale panel has a conversion button that is used to convert images, the clear button is to delete or retrieve other image files, and the save button to save images, Figure 5.



Figure 6. Median Filter Form

The Median menu used consists of grayscale images that have been saved, Noise salt & Pepper, Median Filter and Histogram Image of the user can fill in the code that has been saved, Figure 6.

Type the photo code that has been entered, then click the photo search button and it will display the photos that have been saved, Figure 7.



Figure 7(a) Noise 5%

Figure 7(b) Noise 10%

Image Median is limited by 3x3, 5x5 and 7x7 kernels. 10% noise with 3x3 median kernels, Figure 8.



Figure 8. Noise 10% Kernel 3 X 3 and Histogram Noise 10% Kernel Median 5 X 5

Grayscale image that has been saved, will appear in the database created. Input Code and Name. Then there is the Code and Name pop-up menu to make the order from smallest (Ascend) and from largest (Descend).

V. CONCLUSION AND SUGGESTION

Conclusion of implementing the median filter technique to reduce noise:

1. Median filter is able to minimize noise reduction in the type of salt & pepper in the image. To reduce noise salt & Pepper, Median Filter uses a kernel that is owned 3 x 3, 5 x 5, 7 x 7 and so on.
2. Noise salt & Pepper has the intensity of random numbers which results in the form of numbers 0 and 255 in a spread manner.
3. Median filter is used to reduce noise and histogram is displayed to measure the intensity of the median filter results in graphical form

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