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Implementation of Modified Median Filtering Algorithm for Salt & Pepper Noise Reduction on Image

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Abstract:
Noise is one form of issue in the image, salt & pepper noise is the kind of noise that can be made using a special technique or also due to the conversion from analog signals to digital, the noise can be improved by using algorithms such as the mean filtering, the mid-point filtering and median filtering, median filtering algorithm is widely used for repair image quality, this article will discuss the modification of the median filtering to improve noise in the image by taking the average of neighboring pixels by 2 points from the value of the center clockwise, the value is taken to be processed to retrieve the value of the middle and then the overall result value will be divided to replace the center pixel value 3x3 spatial window.

Keywords: *Median filtering, filtering, image filtering, noise reduction, noise image, algorithm*

1. Introduction

Improvements to the quality image (image enhancement) is one of the initial process in image processing (Boateng, Asubam, & Laar, 2012; Rajasekaran & Kumar P, 2014; Ahmed, Elatif, & T.Alser, 2015). Image quality improvement is needed because the image that made the object has a poor quality(Harish & Gowtham, 2013), for example, experienced a noise image, the image is too dark / light, the image less sharp, and fled (Rajasekaran & Kumar P, 2014; Sakthivel & Prabhu, 2014). Through the initial processing operation is corrected so that the image quality of the image can be used for further applications (Ahmed, Elatif, & T.Alser, 2015), for example for the application object in the image. Image quality improvement is the process of getting images more easily interpreted by the human eye. The purpose is to further highlight the image enhancement feature of certain images for analysis or display the image(Boateng, Asubam, & Laar, 2012; Rajasekaran & Kumar P, 2014; Ahmed, Elatif, & T.Alser, 2015; Sakthivel & Prabhu, 2014).
Median filtering is a technique of image enhancement in the spatial domain. This method is included in the category of non-linear filtering (Boateng, Asubam, & Laar, 2012). The workings of the algorithm are median filtering each pixel output value is determined by the median of environment mask are determined, the pixel values are taken in the form of spatial window with a minimum size of 3x3 and then the existing values are sorted in ascending(Sakthivel & Prabhu, 2014).
This research attempted to modify the median filtering algorithm by taking two pieces of neighboring pixel values in a clockwise direction and then dividing by the number of pixel values are taken, by doing this modification will be known how the digital image quality improvement to noise.

2. Literature Survey

Literally image (image) is an image in the field of bi-dimension or two dimensions. Citra can also be interpreted as a collection of dots with a certain intensity of color that form a union and have an artistic sense. Image as one of the multimedia components that play a pivotal role as a form of visual information. In general, digital image representation requires a large memory. The larger the size of the image is certainly the greater the memory that it needs. On the other hand, most of the image contains duplicate data (Solomon & Breckon, 2011).

2.1. Pixel in Image

Each pixel represents not just a single point in an image but a section in the form of a box which is the smallest part(Solomon & Breckon, 2011). The value of a pixel to be able to show the average value that is equal to all parts of the cell. Besides the discussion of digital images also contained the term resolution of the image (Ahmed, Elatif, & T.Alser, 2015)(Solomon & Breckon, 2011). The image resolution is the level of detail of an image. The higher the image resolution, the higher the level of detail of the image. The units in the measurement of the image resolution can be either physical size (the number of lines per mm / number of lines per inch) or can also be a complete image size (number of lines image width)(Solomon & Breckon, 2011).

2.2. Image Restoration

Digital image enhancement is a process that aims to manipulate and analyze images with the help of a computer, a good image of dimension 2 or 3-dimensional image. Improvements aimed at improving the image quality of the display image to view humans or to convert an image to have a better format so that the image be easily processed by machine (computer). Repairs to an image can be done by the operating point (spatial operation), spatial operations (spatial operation), the operation geometry (geometric operation), and the arithmetic operation. The type of digital image enhancement is as follows:

a. Image Brightness
   brightness image can be corrected by adding or subtracting a constant to or from each pixel in the image. Pixel value conversion results may be less than or equal to the minimum degree of gray (0) equal to or greater maximum degree of gray. Therefore, it is necessary clipping pixel values to grayish minimum or maximum value of gray level.
b. Stretch Contrast
   Stretching the contrast is divided into:
   1) Low-contrast image
      Low contrast image characterized by the majority of image composition is mostly bright or dark. However, it may be an image-Low Contrast classified. Although it is not too bright or too dark when all groupings of gray values are in the middle. Low-contrast image quality can be improved with contrast stretching operation. Through this operation, the values of the pixel gray level ranging from 0 to 255 (in the 8-bit image).
   2) Fine Contrast image
      Fine Contrast image shows a wide range of gray value without the value of gray that dominates.
   3) High-contrast image
      High-contrast image have the value of the gray-value range is wide, but there is a wide area that is dominated by dark colors and wide area dominated by bright colors
c. Refine (Image Sharpening)
   The image sharpening aims to clarify the edges of the objects in the image. Image sharpening is done by passing the image on-passes filters (high-pass filter). Because image enhancement has more influence on the edges (edge) of the object, the image enhancement referred to as edge sharpening or improved quality of edges (edge enhancement). As a result, a suburb of objects appears sharper than the surrounding
d. Screening noise (noise filtering)
   Image quality greatly influenced by the presence of noise, corrupted color image by noise (noise) at the time of image acquisition or for image transmission. Image quality is reduced when the acquisition due to unfavorable environmental conditions and the quality of the sensor element bad tools. A decrease in image quality during the transmission process can be caused by electromagnetic wave interference during the transmission of the image data.
e. Noise Filtering
   Noise in the image may occur due to factors such as the environment and the data transmission channel. Noise on the discussion here is the noise that occurs due to the characteristics of the degree of gray (gray-level) or because of the random variable that occurs due to the characteristics of Probability Density Function (Probability Density Function (PDF)).Some noise in image processing, among others:
   1) Gaussian Noise
   2) Rayleigh Noise
   3) Gamma Noise
   4) Exponential Noise
   5) Uniform Noise
   6) Impulse (Salt-and-Pepper) Noise

2.3. Median Filtering

Median filter method is a non-linear filter developed Tukey (Boateng, Asubam, & Laar, 2012)(Ahmed, Elatif, & T.Alser, 2015)(Sakthivel & Prabhu, 2014), which serves to smooth and reduce noise or interference in the image (Boateng, Asubam, & Laar, 2012). Is said to be nonlinear because the way the filters are not included into the category of convolution operation (Boateng, Asubam, & Laar, 2012)(Ahmed, Elatif, & T.Alser, 2015)(Al-amri, Kalyankar, & S.D , 2010). Calculated by the nonlinear operation sort the group of pixel intensity values (Sakthivel & Prabhu, 2014), and then replace the value pixels are processed with the specified value. At a window, median filter or filters which contains numerous odd pixels shifted points per points over the entire image area. Values are in the window are sorted in ascending and then calculated the value the median. The value will replace the value that is at the center of the field window (Harish & Gowtham, 2013)(Solomon & Breckon, 2011).

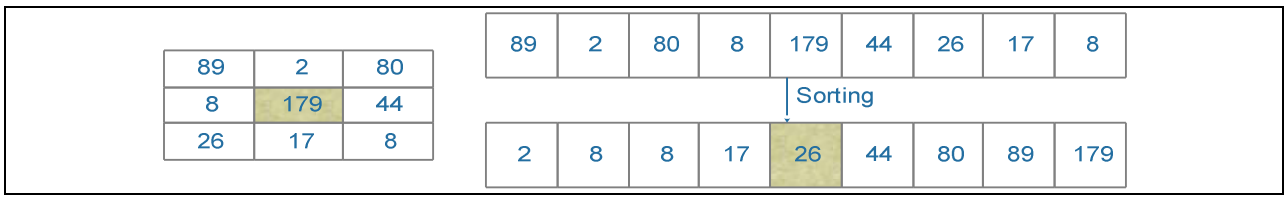

Figure 1: Median Filtering

Value 26 will replace the value of 179 as the output of the median filtering. If a window is placed on a plane image, the pixel value in central areas of the window can be calculated by finding the median value of values the intensity of a group of pixels that have been sequenced. Mathematically formulated as follows:

$$g(x, y) = median\{f(x-i, y-j), (i, j) \in w\}$$

where g (x, y) is an image generated from the image of f (x, y) with was window placed in the field of image and (i, j) element of the window.

3. Proposed Method

Development of detection algorithms noise median filtering is based on the simple concept that if the pixel belongs to the area of uniform, then that is close in color to the pixel neighbor, then it is not corrected, if nothing comes close to the pixel neighbor, then the detected noise then the value of the pixel is replaced with the median of window were evaluated. For the expression of the concept of window, we can consider the difference in intensity between the central pixel and its neighbors, one of the rules for the detection of noise by comparing the average of neighboring pixels selected 2 point clockwise with the center pixel, as an example of the calculation of the development of median filtering for noise detection can be seen as follows:

2	4	5	6	6	5	7
3	5	6	160	4	6	7
1	1	5	6	6	7	8
6	6	5	5	200	6	7
7	7	7	6	5	6	6
3	4	5	5	5	6	7

Table 1: Value Point on Image

The next process is the examination of noise on condition comparing the average pixel neighbors who have two points clockwise with the center pixel, here are the results

$$\text{IF } F(1,1) = \frac{4+3}{2} - 5 \le 10 \text{ Then True}$$

$$\text{IF } F(1,3) = \frac{4+6}{2} - 5 \le 10 \text{ Then True}$$

$$\text{IF } F(3,1) = \frac{3+1}{2} - 5 \le 10 \text{ Then True}$$

$$\text{IF } F(3,3) = \frac{6+1}{2} - 5 \le 10 \text{ Then True}$$

$$F(2,2) = F(2,2) = 5$$

Furthermore, the center point of the window shifts to the position (1,2). The same steps were performed to calculate the average value of the central point window.

2	4	5	6	6	5	7
3	5	6	160	4	6	7
1	1	5	6	6	7	8
6	6	5	5	200	6	7
7	7	7	6	5	6	6
3	4	5	5	5	6	7

Table 2: Matrix 3x3 Position (1,2)

Here is the process for the position (1,2)

$$\text{IF } F(1,2) = \frac{4+5}{2} - 6 \le 10 \text{ Then True}$$

$$\text{IF } F(2,2) = \frac{5+160}{2} - 6 \le 10 \text{ Then False}$$

$$\text{IF } F(3,3) = \frac{5+5}{2} - 6 \le 10 \text{ Then True}$$

$$\text{IF } F(2,3) = \frac{160+5}{2} - 6 \le 10 \text{ Then False}$$

$$F(2,3) = F(2,3) = 6$$

Furthermore, the center point of the window shifts to the position (1,3). The same steps were performed to calculate the average value of the center point of the window.

2	4	5	6	6	5	7
3	5	6	160	4	6	7
1	1	5	6	6	7	8
6	6	5	5	200	6	7
7	7	7	6	5	6	6
3	4	5	5	5	6	7

Table 3: Matrix 3x3 Position (1,3)

$$\text{IF } F(1,3) = \frac{6+6}{2} - 160 \le 10 \text{ Then False}$$

$$\text{IF } F(1,5) = \frac{6+4}{2} - 160 \le 10 \text{ Then False}$$

$$\text{IF } F(3,3) = \frac{6+6}{2} - 160 \le 10 \text{ Then False}$$

$$\text{IF } F(5,5) = \frac{4+6}{2} - 160 \le 10 \text{ Then False}$$

IF ALL Flase Then F(2,4) = (F(1,3):F(3,5)) = 6

Furthermore, the center point of the window shifts to the position (1,4). The same steps were performed to calculate the average value of the center point of the window.

2	4	5	6	6	5	7
3	5	6	6	4	6	7
1	1	5	6	6	7	8
6	6	5	5	200	6	7
7	7	7	6	5	6	6
3	4	5	5	5	6	7

Tabel 4: Matrix 3x3 Posisi (1,4)

$$\text{IF } F(1,4) = \frac{6+6}{2} - 4 \le 10 \text{ Then True}$$

$$\text{IF } F(1,6) = \frac{6+6}{2} - 4 \le 10 \text{ Then True}$$

$$\text{IF } F(3,4) = \frac{6+6}{2} - 4 \le 10 \text{ Then True}$$

$$\text{IF } F(3,6) = \frac{6+6}{2} - 4 \le 10 \text{ Then True}$$

F(2,5) = F(2,5) = 4

Furthermore, the center point of the window shifts to the position (1,5). The same steps were performed to calculate the average value of the center point of the window.

2	4	5	6	6	5	7
3	5	5	6	4	6	7
1	1	5	6	6	7	8
6	6	5	5	200	6	7
7	7	7	6	5	6	6
3	4	5	5	5	6	7

Tabel 5: Matrix 3x3 Posisi (1,5)

Here is the process for the position (1,5)

$$\text{IF } F(1,5) = \frac{5+4}{2} - 6 \le 10 \text{ Then True}$$

$$\text{IF } F(1,7) = \frac{5+7}{2} - 6 \le 10 \text{ Then True}$$

$$\text{IF } F(3,5) = \frac{4+7}{2} - 6 \le 10 \text{ Then True}$$

$$\text{IF } F(3,7) = \frac{7+7}{2} - 6 \le 10 \text{ Then True}$$

$$F(2,6) = F(2,6) = 6$$

4. Conclusion

Development of algorithms median filtering in the detection of noise in the image can be done properly and the results are also quite good, while the processing pixel in the image can be done without having to do the sorting pixel values in advance and the pixel value center can be replaced by the value of the calculation result of median filtering algorithm development.

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