A Modified Median Filtering Algorithm (MMFA)

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Abstract— Median filtering is a nonlinear kind of image filtering which is effectively used in reducing the image noise while maintaining the edges of the image. One advantage of median filtering is eliminating the effect of input noise values with very large magnitudes. Median Filter decreases noise from an image without edge destruction and blurring but the performance will be degraded in a high density of noise. This paper presents an improved median filtering algorithm. The process was modified by identifying the noise density of the image and the window size of the image will be the basis to be used in sorting the pixel. Furthermore, the median value will replace the pixel value in the entire window. The result shows that the modified median filtering has a detailed and clearer output.

Index Terms—Image Filtering, Non Linear, median filtering, Modified Median Filtering Algorithm

I. Introduction

An image is a composition of squared pixels arranged in row and column. It is captured by capturing devices like camera or scanner and stored in the mass storage of the computer system. A captured image is subjected to many kinds of distortion during the stages of processing, storing, compressing, transmitting and others. During the transfer of the image, noise may be added along the actual information.

The unwanted information that added along the required information is due to certain environmental variations and faulty locations during transfer [1]. To answer the problems on these digital modern age, image processing is one of the most useful technique for computer algorithms wherein these algorithms are used to perform the processing on digital images and some function to extract some important data from the image [2].

Analog and digital image processing are the two methods used in image processing. Analog image processing is used for hardcopies like printouts and photographs while digital image processing technique helps to manipulate digital images with the help of a computer. There are three (3) primary groups in image processing, composed of image compression, image enhancement and restoration, and measurement extraction [3][4][5].

Image filtering is a technique for modifying an image. An image will be filtered to emphasize certain features or remove other features [6][7][8]. Linear filtering is used to remove certain types of noise. It reduces noise by convolving the original image with a mask that represents a low-pass filter or smoothing operation. The output of a linear process, due to the sum of two inputs, is the same as performing the process on the data individually and then summing the results. It tends to blur the sharp edges and break the lines and other fine details of the image. It does not preserve the features of the image [9].

On the other hand, nonlinear is a filtering technique through which the output is not a linear function of its inputs. It preserved the details of the image. It has also many applications, especially the removal of certain types of noise that are not additive [10]. Median filtering is a nonlinear digital technique that is used for removing salt and pepper noise. It is widely used in image processing because it keeps the edge characteristics of an image and can reduce impulse noise [11][12].

One of the advantages of median filtering is that it can eliminate the effect of input noise values with very large magnitudes. Median Filter decreases noise from an image without edge destruction and blurring but the drawback of this filtering technique is the performance which will be degraded in a high density of noise [13]. Median filtering removes impulse noise by windowing the noisy image. In this study, the noise density of the image was identified and will be the basis of window sizes to be used in median filtering. The filtered image, using the proposed modified median filtering, will be the input to the recognizer, thus this study.

II. Median Filtering

Image filtering

Filtering is a technique for modifying or enhancing an image. For example, you can filter an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include removing noise, sharpening, and edge enhancement [14] [15] [16].

Linear Filtering

Linear filtering is used to remove certain types of noise. It reduces noise by convolving the original image with a mask that represents a low-pass filter or smoothing operation. The output of a linear process due to the sum of two inputs is the same as performing the process on the data individually and

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then summing the results. It tends to blur the sharp edges, break the lines and other fine details of the image. It does not preserve the features of the image [17].

Non-Linear Filtering

It is a filter which output is not a linear function of its inputs. It preserved the details of the image. It has many applications, especially the removal of certain types of noise that are not additive. Non-linear filters are considerably harder to use and design than linear ones [18].

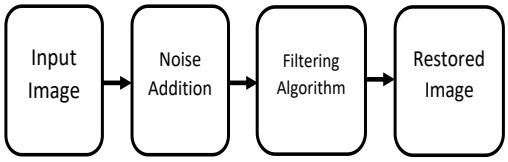

Fig. 1. Image Filtering Block Diagram

Median Filtering

The median filtering is a nonlinear kind of image filtering which is effectively used in reducing the image noise while maintaining the edges of the image. It works in a window of size WM×WN where WM and WN are both odd [13][18]. The median filter works through the image pixel by pixel, changing each value with the median value of neighboring pixels. Likewise, neighborhood refers to the window which slides pixel by pixel through the entire image. This can be computed by first sorting the entire pixel values from the identified window into numerical order and then replace it with the value of the pixel being considered with the middle (median) pixel value. If the neighborhood under consideration consists of an even number of pixels, the median value selected as the output is the average of the two middle pixel values [19]. Figure 2 depicted the process of median filtering. The median filter replaces a pixel by the median, instead of the average, of all pixels in a neighborhood.

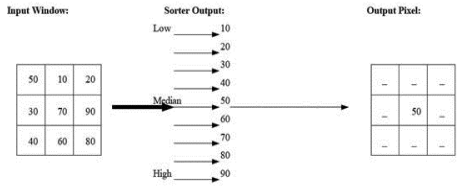

Fig 2. Median Filtering Process

$$y[m,n]=median\{x[i,j],(i,j)\in w\} \quad (1)$$

The above formula was stated wherein the w represents a neighborhood defined by the user, centered round location $[m,n]$ in the image.

Median filtering is a conventional technique in image processing. It is particularly useful to reduce speckle noise and salt and pepper noise. Its edge preserving nature is quite effective [17].

The median filtering algorithm has the good noise-reducing effect, but when the noise has high density, the performance will be degraded [13]

There are different image filtering used to retrieve the deteriorated image. Image filtering commonly used to eliminate noise is median filtering. Median filtering is a robust kind of filter. It is used as smoothers for image processing. The main advantage of the median filter is that it can eliminate the effect of input noise values with extremely large magnitudes. Its edge preserving nature is quite useful. But the time complexity of median filtering is not desirable, and when the noise has high density, the performance will be degraded [13].

Having the weakness of the median filtering, some researchers enhanced this by experimenting with some techniques. In this section, the different enhancements made by the researchers are being mentioned.

To enhance the median filtering, decision methods are being used. It can distinguish the noisy pixel and healthy pixel and can be eliminated the redundant operations. But this enhancement is not guaranteed in all cases [20].

III. The Enhanced Median Filtering Process

This study proposed a density based modified median filtering algorithm (MMFA).

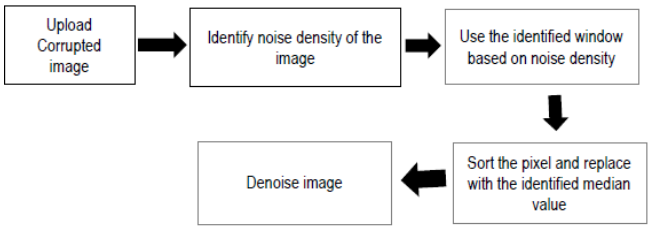

Fig 3. Modified Median Filtering Algorithm

A. The pixel with the value of 0 and 255 (which consider of salt and pepper) are counted from the corrupted image.

```
count = 0
 for every pixel:
        if 0 or 255: (Note: Is it 0 and 255? Maybe 0 or 255?)
                count++
```

B. Calculate the density of noise.

The density of noise will be computed by getting the total number of noise over the total number of the pixel from the inputted image multiplied by 100.

$$Density\ of\ noise\ (DN) = \frac{\sum noise\_count}{\sum pixel\_count} \times 100 \quad (2)$$

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C. The computed density of noise is the basis of the window to be used in sorting the pixel.

The following formula was being used, wherein f(x) represents the window size, DN for density of Noise, and N for Noise in the image.

$$f(x) = \begin{cases} 3x3 \ \ if\ DN \leq \frac{N}{3} \\ 5x5 \ \ if\ \frac{N}{3} < DN \leq \frac{N}{2} \\ 7x7 \ \ if\ \frac{N}{2} < DN \leq \frac{3N}{4} \\ 9x9 \ \ otherwise \end{cases} \quad (3)$$

D. The identified window based on noise density will be used for sorting all neighborhoods into numerical order pixel value. Then sort by window.

IV. Simulation Results

Captured images have been tested to evaluate the performance of the proposed improvement of the median filtering algorithm compared to the conventional median filtering algorithm. The figure below shows that the proposed study has a better result than the conventional median filtering algorithm regardless of the percentage (%) of noise density of the original image

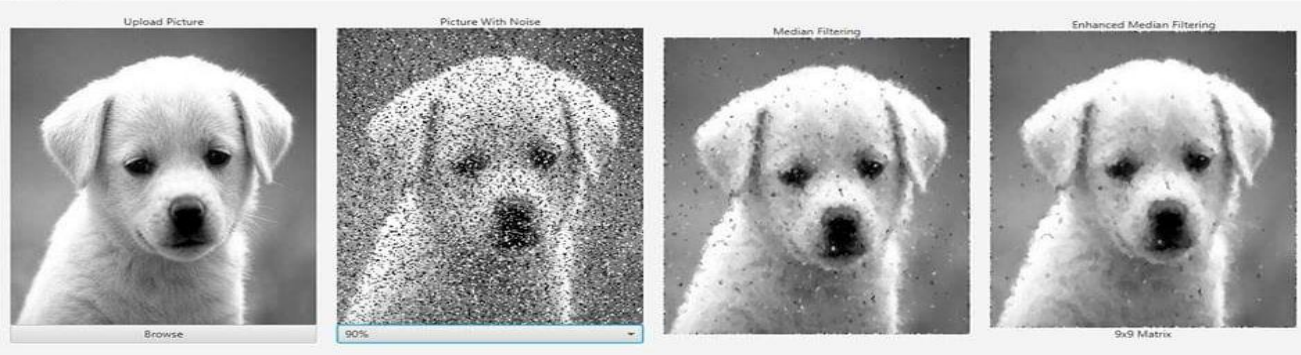

Fig 4. Images with 90% noise density

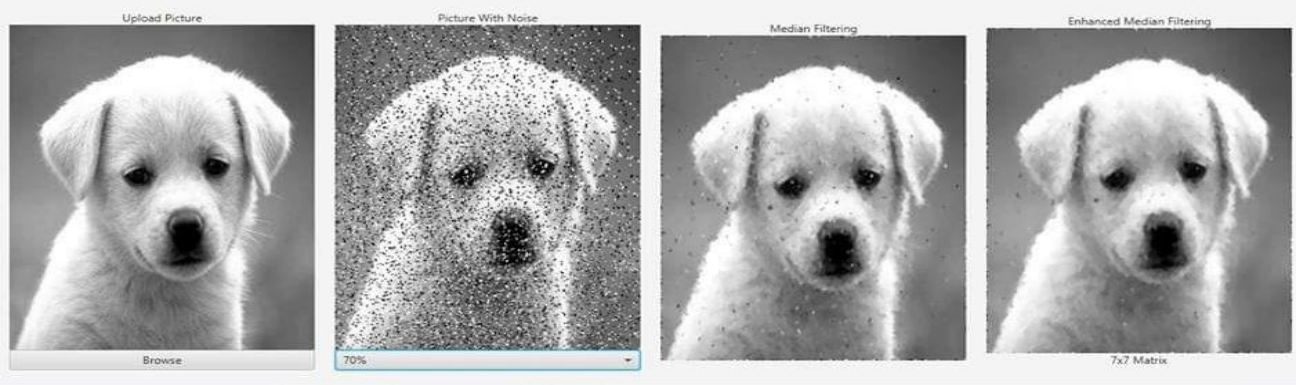

Fig 5. Images with 70% Noise Density

Fig. 6. Images with 50% Noise Density

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V. Conclusion

The results showed that the modified median filtering algorithm (MMFA) has a detailed and clearer output compared to the original median filtering algorithm.

Future Work

This study is a preprocessing step for enhancing the captured traffic images and other images for investigation and documentary purposes.

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