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IMAGE RESTORATION USING NONLINEAR FILTERING BASED RANDOM TRAIL METHOD

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ABSTRACT

The achievement of high image restoration with more image details sharpening median filter based on the random trail method (RTM) is proposed to be used .This paper proposes a weight coefficients (WC) use in median filter (MF) scheme to improve the quality of standard images by removing the salt and pepper noise while simultaneously preserving the other minutiae. The proposed scheme will be tested on noisy standard images and compared to other schemes. The quality of the filtered images will be assessed by computing the mean square error (MSE).

Keywords: *Random Trail Method (RTM), Weight Coefficient (WC), Median Filter, Salt and Pepper Noise.*

1. INTRODUCTION

One of the fundamental objectives of image processing is to improve the visual appearance of images to human viewer and to prepare images for measurement of the features and structures. Presently, a digital image is obtained through a suitable digital imaging system [1]. Although the current technology has tremendously advanced, no imaging system is perfect in generating images that are identical to their originals because of the inherent physical limitations [2].

Images may be degraded due to the imperfection of the imaging system. Images may also be impaired by the addition of various forms of noise, which come from the original source, the encoding and decoding process, or the noisy transmission channels [3]. Image enhancement techniques remove or reduce the noise through the operations performed in the spatial, or frequency domain to obtain a visually improved image. Image restoration and reconstruction techniques apply different approaches to inverse the degradation process to recover the original non degraded image. These image processing techniques enhance the image quality and provide numerous practical applications with distortion corrected and visually improved images [3].

The achievement of high image restoration with more image details sharpening median filter based on the random trail method is proposed to be used. This proposed filter is highly effective and applicable for image sharpening details. Its ability of removing the noise from the noisy image while preserving its details has given better performance compared to other filters. The program is implemented by using MATLAB version 7.0.

2. IMAGE RESTORATION MODEL

Image restoration model can be described in Figure 1.

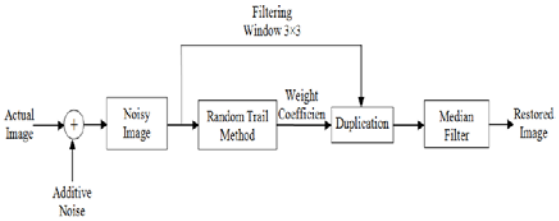

Figure 1: Image Restoration Model

As shown in Figure 1, input image, random trail method, duplication, median filter are the main steps in this proposed method. In the next section, further details about each stage will be investigated.

2.1 Degradation Model

The degradation model process is achieved by adding noise to the image size 256×256. Salt and pepper noise is being used in this model, Figure 2 shows additive noise N(n) to the original image I(n), the degradation operation g(n) produces a degraded image D(n).

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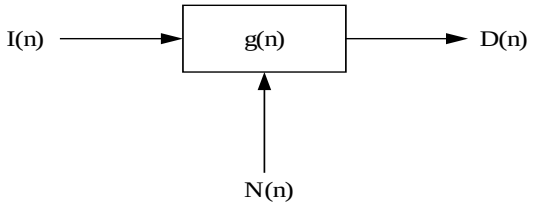

Figure 2: Degradation Model

The salt-and-pepper type noise is typically caused by errors in the data transmission [4], malfunctioning pixel elements in camera sensors, faulty memory locations, or timing errors in the digitization process.

The corrupted pixels are either set to the maximum value (which looks like snow in the image) or have single bits flipped over. In some cases, single pixels are set alternatively to zero or to the maximum value, giving the image a `salt and pepper' like appearance. Unaffected pixels always remain unchanged. The noise is usually quantified by the percentage of pixels, which are corrupted [5].

In Figure 3 is the salt and pepper distribution:

$$HISTOGRAM = \begin{cases} A \ \ for \ \ g = a \ \ (" pepper") \\ B \ \ for \ \ g = b \ \ (" salt") \end{cases} \qquad (1)$$

In the salt and pepper noise model there are only two possible values, a and b, and the probability of each is typically less than 0.1 with numbers greater than this, the noise will dominate the image. For an 8 bit image, the typical value for pepper noise is 0 and for salt noise, 255 [6].

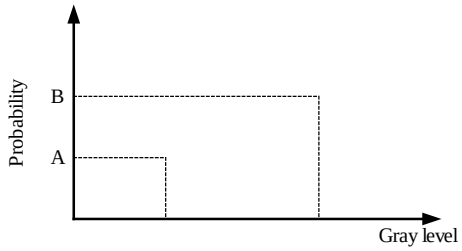

Figure 3: Salt and Pepper Noise Distribution

2.2 Random Trail Method

The output of previous stage is noisy image, which will use as an input for the random trail method. The random trail method helps to determine the weight coefficients (WC) for the median filter. The flowchart, which illustrated in Figure 4, appears the flow operations and the procedures for getting weight coefficients.

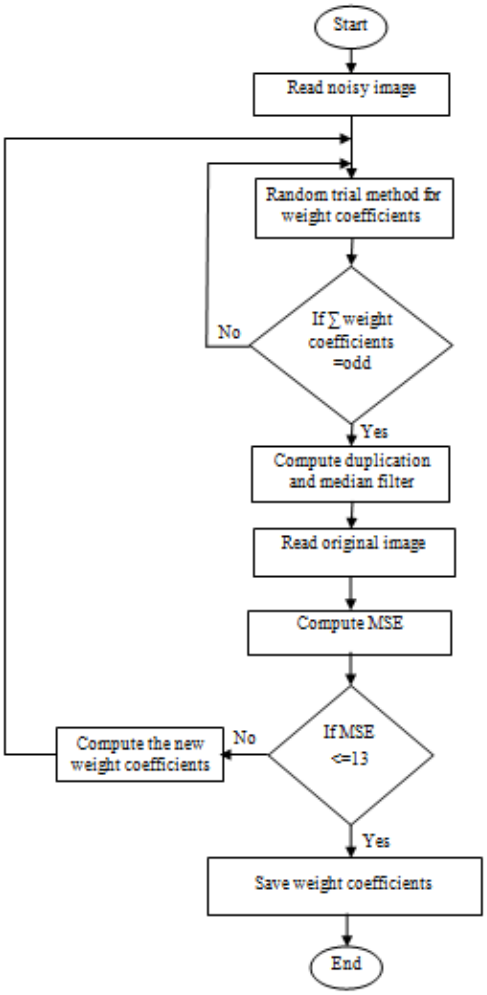

Figure 4: Weight Coefficients Procedures

2.3 Duplication Structure

Figure 5 illustrate a structure of the duplication.

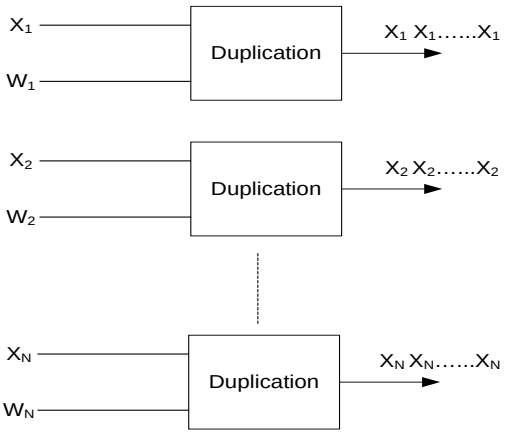

Figure 5: Duplication Structure

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As shown in figure 5, each sample X_i is duplicate to the number of the corresponding weight W_i as shown in (2) and (3).

$$X = [X_1, X_2, \cdots, X_N] \quad (2)$$

$$W = [W_1, W_2, \cdots, W_N] \quad (3)$$

The output of duplication is determined as follows:

$$Y = [W_1 \circ X_1, W_2 \circ X_2, \cdots, W_N \circ X_N] \quad (4)$$

where $\circ$ denotes duplication, i.e.,

$$T \circ X = \overbrace{X, \cdots, X}^{T \ times} \quad (5)$$

2.4 Median Filter

Median filters are especially good at removing impulsive noise from images. The particular nonlinearity of the median filter permits it to smooth an image without the degree of blurring that a linear filter with similar smoothing characteristics can introduce [7]. Figure 6 shows a typical example for the median filter; the median filter's mask used here is (3×3) mask.

Median filter replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel (the original value of the pixel is included in the computation of the median).

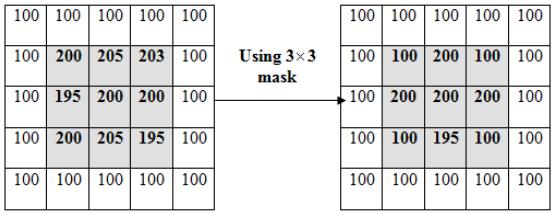

Figure 6: Calculating the Median Value of a Pixel Neighborhood [5]

3. EXPERIMENTAL RESULTS

The random trail set of weight coefficients is shown in Figure 7. The performance of proposed filter using this set of weight coefficients is compared to those of average filter [8] and median filter.

1	4	5
5	7	5
6	7	3

Figure 7: Random trail Result of Weight Coefficients

Figures 8 to 10 shows the images that have been restored using the proposed filter, salt and pepper noise with average and median filter have been compared.

Figure 8: Salt and Pepper noise 5% with Average Filter (MSE=46.1051)

Figure 9: Salt and Pepper noise 5% with Median Filter (MSE=14.9782)

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Figure 10: Salt and Pepper noise 5% with Proposed Filter (MSE=12.7739)

From all above, it is noticed that a little enhancement of the image details is obtained by average filter with very frustrating increase in the noise corruption. The median filter is more controlling. The result yielded by a median filter shows that median filter behaved better than the average filter but sensitivity to noise is clearly perceivable. The result observed that proposed filer based on random trail method removes noise availably, at the same time; details of image are preserved effectively.

4. CONCLUSION

A new method to improve the quality of images by removing salt and pepper noise using median filter based on random trail method has been proposed in this paper.

From the results, proposed filter has removed the noise available, while details of image are preserved effectively in comparison to the rest of other filters (average filter and median filter).

It has been observed that the MSE of proposed filter has less MSE than the other filters.

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