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An Efficient Threshold Based Mixed Noise Removal Technique

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***Abstract*—** Removing or reducing noises from image is very important task in image processing. This paper presents an efficient noise removal technique to restore original digital images corrupted by mixed noise. The proposed filtering technique consists of three steps: noisy pixel detection using fuzzy flag, mixed noise filtering step and calculating threshold value remove the pixel value with replacement conditions. Noises in this methodology are the combination of gaussian noise and salt and pepper noise. This methodology reduces the mixed noise without losing edges sharpness and information. This methodology gives better results existing many fuzzy algorithms. The proposed technique shows better peak signal noise ratio result with thresholding replacement conditions. Hence, this mixed noise removal technique finds application in numerous segments of image process like digital TV, medical image process, camera, police work systems etc. Wiener filter is used for image enhancement.

Keywords-*Impluse Noise, Gaussian Noise,Salt and Pepper Noise, Thresholding, Wiener flter.*

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1. INTRODUCTION

Digital image plays a very important role in our existence and within the space of analysis and technology. When the digital image is transmitted from one place to a different place, during the transmission noise is superimposed into the image. Any style of signal process having image as associate input and output is named image process. The interference throughout the transmission degrade the information. Noise may be generated by the transmission error and compression.

Quality degradation takes place in digital images because of corruption by completely different types of noises like salt and pepper noise, Gaussian noise, mixed noise etc. Salt and pepper noise (impulse noise) presents itself as sparsely occurring white and black pixels in a picture. Gaussian noise is that the applied statistical noise having a noise likelihood Probability Density Function(PDF) capable that of the conventional distribution, that is additionally called the statistical distribution Mixed noise refers to a mixture of various varieties of noises, throughout acquisition by camera sensors or throughout transmission within the cannel, noises will get else within the image, a crucial image process operation in image and video is image denoising. Various algorithms are already accessible to get rid of impulse noise that preserves image details additionally. Median filter is one of them, that has effective noise suppression capability. But, most of the median filters tend to switch each buzzing and noise-free pixels since they are enforced uniformly across the image. The common state of affairs is that effective removal of impulse noise is usually accomplished at the expense of distorted and blurred options, therefore removing fine details within the image. Once it involves mixed noise, the task is additional tedious.

A mixed noise (Impulse noise and Gaussian noise) removal algorithm based on noisy pixel modification technique, mixed noise filter, calculate threshold value, output image replaced by three replacement conditions. The proposed method successfully removes mixed noise from highly corrupted images very efficiently while highly preserving image details. The experimental results show that the proposed method outperforms better than many other filtering techniques.

2. RELATED WORK

M and Narayanan [1] highlighted an Efficient Mixed Noise Removal Technique from Gray Scale Images using Noisy Pixel Modification Technique. The proposed filtering technique consists of two steps: the noisy pixel detection step using fuzzy technique and the mixed noise filtering step. Noises addressed in this method are a combination of salt and pepper noise and Gaussian noise. In this paper, an efficient mixed noise removal technique from gray scale images is presented. Extensive computer simulations indicate that it outperforms significantly many other well-known algorithms. The proposed technique can be used in many consumer electronic products to remove mixed due to its performance and low complexity.

Irum et al. [2] highlighted the composed of a sequence of morphological standard and operations erosion-dilation and trimmed standard median filter. It removes the salt and pepper noise without losing the image features, color components and edges. A sequence of these operators with trimmed median filter has been completely work that removes the salt & pepper noise from color images very well. The results evaluate the performance of proposed filter and measure peak signal noise ratio. Proposed filter better removes the noise from edges and without distorting the features and color components.

Murugan and Avudaiappan [3] discussed a comparative Analysis of Impulse Noise Removal Techniques on Gray Scale Images. This paper investigates the performance of four methods for removing the High Density Impulse Noise. They are Adaptive Bilateral Filter, Fuzzy Peer Group Filter, Switching Bilateral Filter, and Boundary Discriminative Noise Detection Filter. In this paper, High Density Impulse noise detection and reduction techniques were implemented and the results were compared by using five performance parameters. They are Peak-Signal-to-Noise-Ratio, Mean Square Error and structural similarity index measure, Mean Absolute Error, and Maximum Difference. Boundary Discriminative Noise Detection Filter method performed better than other methods.

Malik and Smolka [4] highlighted a new approach to the problem of noise removal in color images is presented. The proposed filtering design is a modification of the bilateral denoising scheme, which takes into account the similarity

between color pixels and their spatial distance. In the paper a novel filtering scheme has been proposed and analyzed. The results of the performance indicate that have very good restoration quality has been achieved for color images contaminated by strong mixed Gaussian and impulsive noise. The beneficial feature of the proposed method is the removal of mixed noise and the ability to restore image edges and fine details. In future to investigate the efficiency of the proposed design with spatial distance parameter which penalizes long paths exploring the local filtering window.

Vishwa [5] focused a new threshold estimation technique during which associate ovary image in .jpg format is injected salt & pepper noise. The proposed threshold mentioned during this paper shows better performance over different techniques. So we are saying that the proposed threshold find applications in image recognition system, image compression, medical ultrasounds and a bunch of different applications. Ovarian cancer is the fifth most typical cancer among women and it causes more deaths than the other kind of female reproductive cancer.

Vala and Baxi [6] discussed various Otsu algorithms for image segmentation. The Otsu algorithm has been widely used because of its simplicity. Here, a comparative analysis regarding different ways of implementing Otsu algorithm with respect to their methods, results and limitations are compared. Otsu method is one of the most successful methods for image thresholding. Otsu is an automatic threshold selection region based segmentation method.

Yang and Lee [7] highlighted an effective denoising algorithm for Poisson-Gaussian noise is proposed using the contour let transform, hidden Markov models and noise estimation in the transform domain. Author supplement the algorithm by cycle spinning and Wiener filtering for further improvements. The HMM algorithm adopts an independent mixture model to match the non-Gaussian nature of the contour let coefficients and adopts hidden Markov models to characterize the key dependencies between the contour let coefficients. Furthermore, this method estimates optimal HMM parameters using the EM algorithm. The Poisson Gaussian noise variance in contour let domain is obtained by filtering the noise variance of each pixel with the square of the contour let filter coefficients. Using the estimated HMM parameters of the signal and noise variances, the signal-dependent noise is reduced through Bayesian estimation.

3. SOLUTION METHODOLOGY

In this paper noises are considered of mixed noise which is salt and pepper noise and gaussian noise. An image pixel value may be positive impluse or negative impluse. Image corrupted by salt and pepper noise and gaussian noise is adding for testing purposes. First mixed type of noise added in the image then detection the noisy pixel. Our proposed technique consists of these steps:

A. Noisy Pixel Detection

a) To calculate the centred value of each and every pixel of an image I.

b) Then we calculate the maximum value Mij, actual pixel value xij and center pixel value sij i.e | xij -sij | for all the sij ≠ xij .The value of Mij guide us to detect whether the pixel is noise free or noisy.

c) As per the value of pixel xij, according to T1 and T2, we consider the fuzzy flag fij which gives us the status of each pixel that whether it is noise free or noisy pixel.

i) If Mij <= T1 Then fij = 0
ii) Else if Mij > = T2 Then fij = 1
iii) Else if T1 <= Mij <= T2
Then fij = (Mij – T1) / (T2 –T1)
Where T1 = 15 and T2 = 25

B. Mixed noise remove using median filter

$$yij = (1 - fij) * xij + fij * mij \quad (1)$$

where fij is the membership function for each pixel, xij is the original value of image, mij median value of Wij.

C. Calculate threshold value

Calculate the actual threshold value using existing algorithms. Replace pixel value of the image with threshold replacement conditions.

i) If the difference between threshold values is of only 1 pixel value then yij remains unchanged and we restored its value yij as xij and it shows noise free pixel.

ii) Else if the difference is greater than 1 then we restored the value of yij with the Median which shows heavily corrupted noisy pixel.

iii) Else if mij > T1 and mij < T2 then we calculate the yij by using a linear combination formula of fij, xij and mij. The equation is:

$$yij = (1 - fij) * xij + fij * mij \quad (2)$$

D. Apply Wiener Filter

Wiener filter is used for image enhancement.

4. RESULTS

To assess the performance of the proposed filtering technique, experimental results with images having distinctly different feature. The PSNR (Peak Signal-to-Noise Ratio) is a tool for measuring the distortion between the original and the recovered signals, which is evaluated in logarithmic decibel scale. PSNR is used to assess the restoration results, which measures how close the restored image is to the original image. The PSNR (dB) is defined as

$$error=(yij-I) \quad (3)$$

$$MSE = (sum(sum(error .* error))) / (M * N) \quad (4)$$

$$PSNR= 10\log_{10}(255^2/MSE) \quad (5)$$

where, MSE is Mean Squared Error ,yij is output image and I is original image.

In Table 1, the performance of the proposed method is compared with previous technique algorithm[1]. The different types of noise percentage are added in the image used for this comparison. Salt and pepper noise and Gaussian noise with varying density were added to the tested image one by one to obtain a noisy input The results of experiments are listed in Table 1, along with the result of the previous technique algorithm[1]. From Table 1, it is clear that the proposed algorithm provides significant improvement over the previous technique.

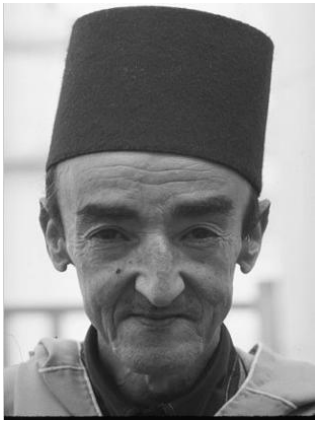

Figure 1 Original Image

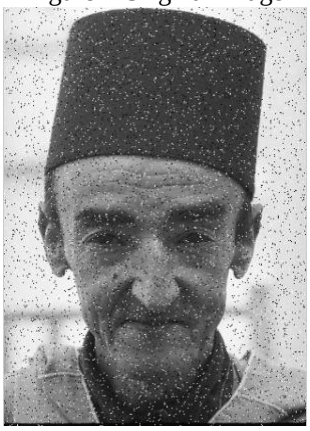

Figure 2 Noisy Image with Salt and Pepper noise 13% and Gaussian noise 5%

Figure 3 Image after filtering proposed technique

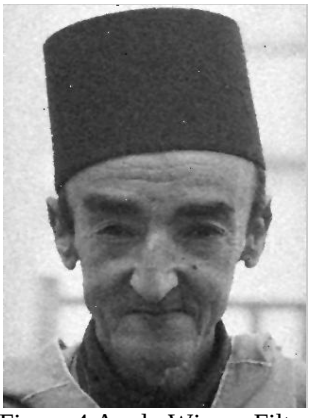

Figure 4 Apply Wiener Filter

Figure.1,orginal image, Figure.2,shows images after adding mixed noise, Figure.3,images after applying the proposed filter. Figure.4,apply wiener filter for enhancement Table1, shows the performance evaluation of the proposed filter and the previous technique for comparison.

From Table 1, it is clear that the proposed filter outperforms the previous technique. Since each pixel in the entire image is tested to check whether it is noisy or noise free, and only the noisy pixel is replaced with the filtered value, the fine structures and sharp intensity edges are preserved. The proposed filtering framework has a simple structure and greatly outperforms the previous technique algorithm for PSNR values and high image quality

Table 1 Comparison of PSNR values

Salt and pepper noise(%)	Gaussian noise(%)	PSNR in db (Proposed filter)	PSNR in db(Previous techinque[1])
5	5	80.463	45.9424
7	5	80.2383	45.9197
9	5	79.9916	45.9436
11	5	79.4158	45.832
13	5	79.0868	45.7873
15	5	78.6842	45.737
17	5	77.7074	45.5867
19	5	77.3924	45.3515
21	5	76.4832	45.2913
23	5	75.3297	45.21

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5. CONCLUSION

This Proposed technique is quite better than previous technique. Noise removed by median filter from the image by using three replacement conditions which is used in our proposed paper. Median filter is very good filter to remove the noise. The proposed technique use threshold value concept and remove mixed noise in the image. Threshold value which remains ideal complete the image that is intensity of pixel vary in acceptable manner. Comparison table shows that PSNR value of the proposed technique is better than previous technique.

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