Enhanced Performance in Salt and Pepper Noise Denoising Method using Discrete Wavelet Transform

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Abstract— Many denoising algorithms are designed to recover a noise infected image. However, most of them cannot well recover a significant noise dirtied image with noise density higher than seventy percentages. A brand new approach projected to remove background noise with efficiency by detecting and modifying noisy pixels in a picture. If the middle pixel of a local window is classed to clamorous, this center pixel is replaced by a weighted norm on associate degree optimum direction, facultative impulse noise to be removed. Conversely, the middle pixel is unbroken unchanged once it's classified to noise-free, yielding the standard of repaired image being well maintained. The algorithmic rule of salt and pepper noise, DWT (Discrete Wavelet Transform) Denoising that exhibits excellent performance each in denoising and in restoration, may be simply and effectively parallelized to use the complete power of multi-core processor performance. The projected Discrete Wavelet Denoising implementation supported the quick Flow library achieves each close-to-ideal quickening and incredibly excellent wall-clock execution figures.

Key words: Adaptive Median Filter, Salt and Pepper Noise, Median Filter, Principal Component Analysis Filter

I. Introduction

The ever increasing computing power on the obtainable from off the-shelf processors has allowed researchers to increase the quantity of applications in image process and machine vision. One essential step in any machine vision system is that the image restoration segment, that has gathered the interest of image process researchers, particularly with the large production of digital pictures and movies, usually grabbed in poor conditions. A typical noise that affects digital pictures is "Salt and Pepper" noise [1], which can be caused by malfunctioning pixels in camera sensors, faulty memory locations in hardware or transmission in a clamourous channel [2]. The previous work on noise sets the corrupted pixel value to the largely or the lowest of the pixels variation range (0 or 255 for an 8-bit image). Throughout the last fifteen years, an oversized range of methods such as mean filters, median filters, fuzzy denoised are proposed to handle salt and pepper noise (and additional generally impulse noise) from digital pictures [3]. Most of these methods measure order stastistic filters that exploit the rank order information suitable set of noisy input pixels. The median filter is that the preferred non-linear filter for removing impulse noise, owing to its smart denoising power [2] and its computational efficiency [4], however it affects image details whereas removing noise. These problems are usually self-addressed by filtering techniques supported the median filter modifications [5], [6].However, the performance of median filtering primarily based approaches is unacceptable in suppressing signal-dependent noise [7] once the noise percentage is high (more than 50%). To realize a decent compromise between the image-detail preservation and therefore the noise reduction an impulse detector should be used before filtering. Many kinds of impulse detectors exist: the well known is that the progressive switch median (PSM) [8]. Machine learning approaches have conjointly been wide utilized in the last years, e.g. approaches counting on neural networks [9], Bayesian networks [10], DWT logic [11] and neuro - DWT [12]. The filtering is then by selection applied to the noisy regions detected by the noise detector. During this technique one the foremost effective algorithmic rule for edge conserving in salt and pepper denoising has been designed by Nikolova in [13] that applies a variational methodology for image details conserving that's supported a data-fidelity term associated with the impulse noise. Supported this approach Chan et al. in [14] (called for simplicity Chan's method) proposed a forceful filter able to take away salt and pepper noise as high as ninety percentages. Similar approaches to the Chan's methodology, aiming at increasing the noise detection step and at reducing the process times, are those planned in [10] [15]. An optimized version of the Chan's methodology is introduced and tested with various test pictures. Moreover, the algorithmic rule has been parallelized using Fast Flow [15], a framework for parallel programming over multicore platforms, and GPU (Graphics process Unit) programming for growing the effectiveness of the filter so as to be truly compatible with real-time applications.

II. Background work

A. Median Filter

The median could also be a mathematics construct whereby throughout a given sorted list of numbers, the median is that the middle value of the list. The median in signal method was first introduced by J. W. Tukey. If the count of the list is even, there could also be multiple center values. If the count of the list is odd, there is one distinctive median value; therefore, it's convenient to use odd list sizes once looking for a median. The Median Filter is performed by taking the magnitude of all of the vectors within a mask and sorting the magnitudes. The pixel with the median magnitude is then accustomed replace the essential pixel studied. The Simple Median Filter features over the Mean filter during this it depends on median of the pixel information fairly than the mean. As single noise pixel gift among the image can significantly skew the mean of a cluster. The median of a group is further study with reference to the presence of noise. The standard median filter is straightforward and economical in removing the impulse noise. It's been very fashionable for several years. Throughout this technique, there is a square window for filtering, and so the window size is variable. The center pixel inside the window is that the one to be de-noised. Its grey worth is going to be twisted into the value of the standard median of the square window that has been sorted.

B. PCA Filter

The standard median filter performs well as long because the spatial noise density of the salt and pepper noise is not huge. The filter performance degrades once the spatial noise variance of the salt and pepper noise will increase. Further with larger image and because the size of the kernel will increase, the particular details and also the edges become obscured. The quality median filter does not take into consideration the variation of image characteristics from one pixel point to another pixel point. The behaviour of adaptive filter changes supported applied math characteristic of the image within the filter region defined by the m x n rectangular window Sxy.

C. Non-Local Means Filtering

The approach of Non-local means filter was introduced by Buades in 2005 supported non-local means of all pixels within the image. The approach was supported denoising a picture corrupted by white mathematician gaussian noise with zero mean and variance. The approach of Non Local filtering is predicated on estimating each and every pixel intensity from the information provided from the complete image and thus it exploits the redundancy caused as a result of the presence of comparable patterns and options within the image. During this technique, the restored grey value of every pixel is obtained by the weighted average of the grey values of all pixels within the image. The weight assigned is proportional to the similarity between the local neighbourhood of the pixel under consideration and also the neighbourhood value alternative pixels within the image.

III. PROPOSED METHODOLOGY

The original test image is corrupted with simulated salt and pepper noise with totally different noise variance starting from 0.1 to 0.3. In the proposed denoising approach, the noise image is first applied to a DWT (Discrete Wavelet Transform) filter. The maximum allowed size of the window of the DWT (Discrete Wavelet Transform) filter is taken to be 5X5 for effective filtering. The choice of maximum allowed window size depends on the application however an logical value was computed by experimenting with varied sizes of standard median filter. In the second stage the resultant image is subjected to NL-means filtering technique.

The performance of the filter depends on,

- Radio of search window (value taken 6)
- Radio of similarity window (value taken 9)
- Degree of filtering (taken adequate to the worth of noise variance divided by 5).

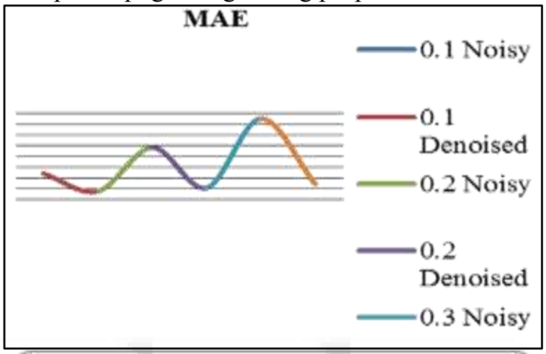
The performance of the proposed technique is quantified by using various performance metrics such as, mean average error (MAE), mean square error (MSE), and signal to mean square error (S/MSE), signal to noise ratio (SNR) and peak signal to noise ratio (PSNR).

A. Denoising Performance

Salt and pepper noise was added to the original test images with noise variance ranging from 0.1 to 0.9. The performance metrics for the noisy and denoised images are shown in Table 1.The performance of the proposed algorithm is tested for various levels of noise variance in ‘parrot.png’ image and compared with standard filters namely Standard Median Filter (MF) of window size (3x3) and (5x5), DWT (Discrete Wavelet Transform) Filter (AMF), in terms of Mean Absolute Error (MAE) [13], Mean Square Error (MSE).

Variance	Image type	MAE	MSE
0.1	Noisy	0.05	0.03
	Denoised	0.02	0.01
0.2	Noisy	0.10	0.07
	Denoised	0.02	0.01
0.3	Noisy	0.15	0.10
	Denoised	0.02	0.01

Table 1: Performance matrices for noisy & denoised “parrot.png” image using proposed method



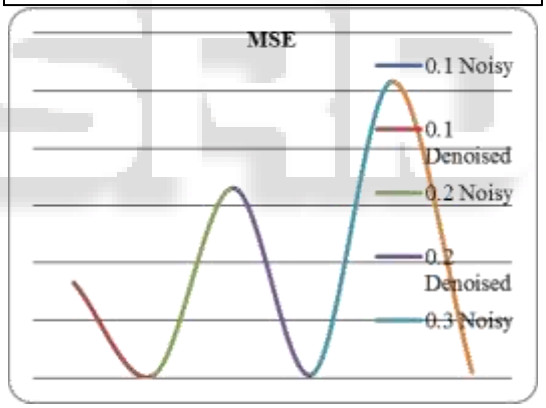


Fig. 1 & 2: Graphical analysis of performance matrices for “parrot.png” image

The Proposed Method performs best in terms of the peak signal-to noise ratio (i.e. PSNR). Experimental results obtained in Table 2, show that at higher noise variance the proposed method DWT denoising restores the original image much better than standard non-linear median-based filter and DWT (Discrete Wavelet Transform) filter.

Variance	Image type	SNR	PSNR
0.1	Noisy	7.94	62.93
	Denoised	22.88	78.92
0.2	Noisy	5.70	59.93
	Denoised	21.14	77.19
0.3	Noisy	4.49	57.98
	Denoised	19.19	75.26

Table 2: Performance matrices for noisy & denoised “parrot.png” image using proposed method

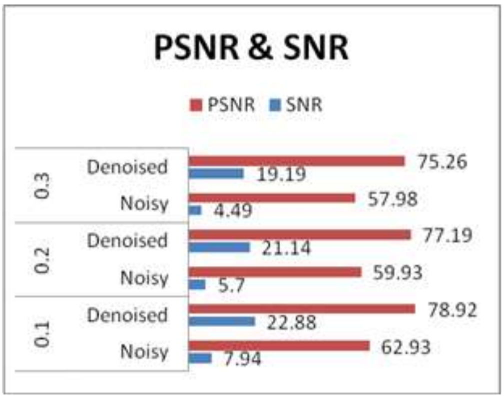


Fig 3: Graphical analysis of performance matrices for "parrot.png" image

IV. CONCLUSION

After the analysis of the test results, the non-local means algorithm tested to be an improved algorithm for image denoising, than its predecessors. The DWT Denoising filtering performed poorly on all the test cases. The denoised pictures still contained essential quantity of noise. The Wiener filter managed to perform a bit higher than the DWT Denoising filter. However, the denoised pictures still seemed to be unclear. it had been ready to recover extreme detail of the preliminary image from the clamourous image. Due to ability to eradicate noise whereas preserving nice detail, the NLM methodology could be an extremely productive manner of approaching image denosing. In this paper there are two new filters for removing impulse noise from pictures are reviewed. The non-local algorithm assumes the idea of self-similarity, rather than creating the higher than mentioned assumptions. this idea of self-similarity is employed within the NLM algorithm to perform image denoising.

REFERENCES

[1] Raymond H. Chan, Chung-Wa Ho, and Mila Nikolova, "Salt-and-Pepper Noise Removal by Median- Type Noise Detectors and Detail-Preserving Regularization"- IEEE Transactions on Image Processing, Vol. 14, No. 10, October 2005.

[2] H. Hwang and R. A. Haddad, "Adaptive median filters:new algorithms and results," IEEE Transactions on Image Processing, 4, pp. 499–502, 1995.

[3] V.Jayaraj, D.Ebenezer, K.Aiswarya, "High Density Salt and Pepper Noise Removal in images using Improved Adaptive Statistics Estimation Filter", IJCSNS International Journal of Computer Science an 170 d Network Security, VOL.9 No.11, November 2009.

[4] Buades,A.,Coll,B.,Morel,J.M., "A non local algorithm for image denoising", Computer vision and Pattern Recognition, 2005,CVPR 2005, IEEE Computer Society Conference on Vol 2,pp,60-65,2005.

[5] V.R.Vijaykumar, P.T.Vanathi, P.Kanagasabapathy and D.Ebenezer, "Robust Statistics Based Algorithm to Remove Salt and Pepper Noise in Images", International Journal of Information and Communication Engineering 5:3 2009.

[6] Buades,A.,Coll,B.,Morel,J.M., "A review of image denoising algorithms with a new one", Society for Industrial and Applied Mathematics,Vol-4,No 2,pp.490-530,2005.

[7] T.K.Thivakaran,RM.Chandrasekaran,"Non Linear Filter based Image Denoising using AMF Approach", International Journal of Computer Science & Information Security, Feb 2010.

[8] Behrooz Ghandeharian, Hadi Sadoghi Yazdi And Faranak Homayouni," Modified Adaptive Center Weighted Median Filter For Suppressing Impulsive Noise In Images", 2009.

[9] P. Rajesh, E. Kiran Kumar, B. Sony Rama, PVV Kishore, " Restoration of High Density Salt and Pepper Noisy Gray & Color Videos using MDBUTMF", International Journal of Emerging Technology and Advanced Engineering ,ISSN 2250-2459, Volume 2, Issue 9, September 2012.

[10] Abdessamad benhamza, pedrol. Luque-escamilla, jose martinez-aroza, ramon roma n-roldan, "Removing Noise and Preserving Details with Relaxed Median Filters", Journal of Mathematical Imaging and Vision 11, 161–177 (1999).

[11] Mamta Juneja, Parvinder Singh Sandhu, "Design and Development of an Improved Adaptive Median Filtering Method for Impulse Noise Detection", International Journal of Computer and Electrical Engineering, Vol. 1, No. 5 December, 2009.

[12] Robert Fisher, Simon Perkins, Ashley Walker, Erik Wolfart, "Image Synthesis- Noise Generation", 2013.

[13] Tudor Barbu, "Variational Image Denoising Approach with Diffusion Porous Media Flow", 2013.

[14] Dr.Padmavathi G, Dr.Subashini P, Muthu Kumar M and Suresh Kumar Thakur, "Comparison of filters used for underwater Image-Preprocessing", IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.1, January 2010.

[15] Arias-Castro E and Donoho D L, "Does median filtering truly preserve edges better than linear filtering",2009.