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HYBRID DIGITAL IMAGE DENOISING ALGORITHM AND ITS PERFORMANCE ANALYSIS

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ABSTRACT

Visual data transmitted as digital images is frequently corrupted by noise. So, the corrupted images are firstly denoised for getting better image quality at the receiver end. For choice of denoising algorithm, it is important to have knowledge about types of noise affecting the image. In this paper, Fast Non Local Mens denoising algorithm is introduced which uses combination of Transform and Spatial domain filtering.

KEYWORDS- *Hybrid Denoising algorithm, Wavelet Transform, Spatial domain filtering, Time domain filtering, Method noise*

I. INTRODUCTION

The importance of visual information transmission can be seen in the field of medical science such as Computer tomography, MRI scan, X-ray Imaging and many other areas. Generally, denoising algorithms are used for image restoration and removal of noise affecting the image. These noises introduced while image capturing, transmission or storage. Noise generally interferes with the original image and degrades the visual quality of it. These corrupted images are passed through denoising process and then restored image is used in another application [25].

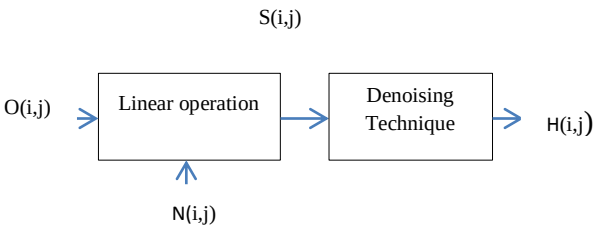

Fig. 1 Concept of Denoising

The noise N(i,j) is linearly added or multiply to the original image O(i,j). So the denoising technique is mainly used to remove the noise that is corrupting the image. But till now exact original image is not being recovered by any method [23].

Although researchers have developed various techniques, but no individual technique has yet been able to achieve absolute results. Hybrid approach is adopted these days, which merges more than one technology [29]. This approach handles the disadvantages of individual techniques while enhancing the advantages.

II. RELATED WORK

B.K. Shreyamsha Kumar proposed of using Non Local Means and method noise thresholding [4]. This method reduced the loss of the fine image details and improved PSNR. But the major drawback of this technique that it takes very high processing time which is due the use of traditional non local means filter. Yongqin Zhang proposed the concept of self-similarity of patches for the noise removal [10]. This method preserves the edges and the fine details of the image efficiently. Till now, no individual technique has yet been able to remove noise from noisy image completely. The researchers are trying to improve the currently used methods so as to achieve optimum results. The traditional algorithms such as non local means, wavelet transform or Curvelet transform are improved by finding solutions to their shortcomings [28]. The hybrid technologies have led to development

of some state-of-the-art algorithms. The fusion of spatial and transform domain filtering has led to the development of very strong denoising algorithms [31]. The shortcomings of the traditional methods are being overcome and the computational time is also reduced along with high PSNR and SSIM values.

III. PROPOSED ALGORITHM

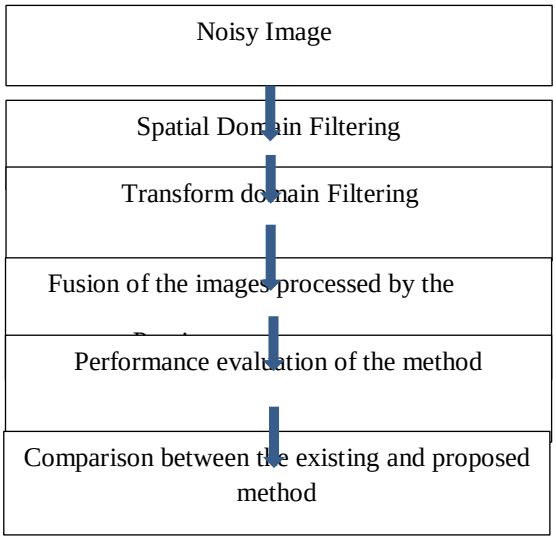

Fig. 2 Flowchart depicting the methodology of proposed algorithm

IV. EXPERIMENTAL RESULTS

The comprehensive experimentation of the proposed algorithm was carried out on a data set consisting of images of different sizes (256 x256, 512 x 512 and 1024 x 1024). The input images were corrupted by simulated Gaussian noise with zero mean and 3 different standard deviations $\sigma_n \in [10, 15, 20]$. The comparison between the proposed method and the existing methods is done based on various parameters. The dataset consists of various images. A total of 30 images have been tested including all types of images such as images having different size, contrast, brightness etc. the proposed algorithm is implemented in Matlab 6.0. Various analysis parameters are chosen such as PSNR, MSE, Computational time etc. to check the effectiveness of the proposed algorithm.

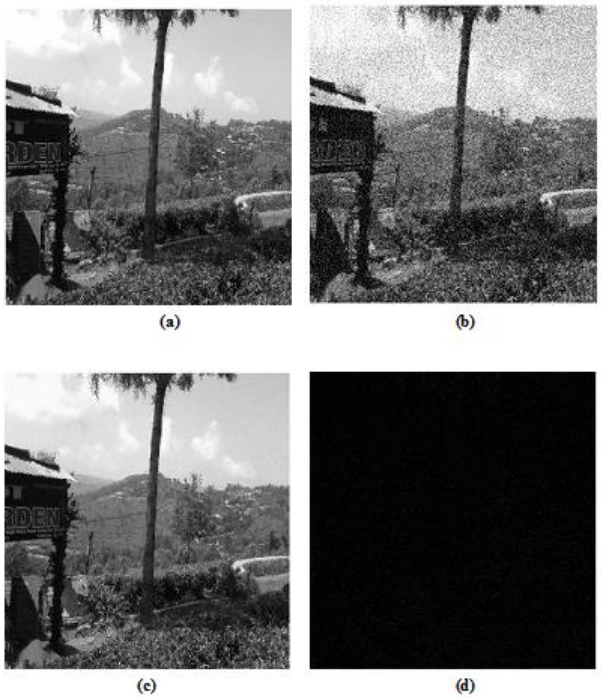

Fig. 3 (a) Original image, (b) Noisy image σ_n=15, (c) Denoised image and (d) Method Noise

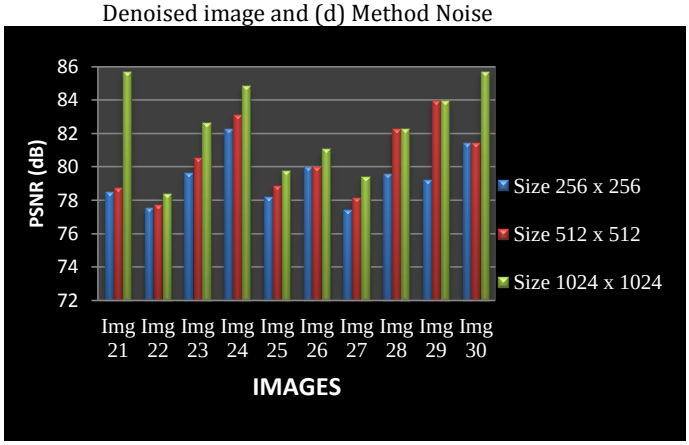

Fig. 4 Bar Graph indicating the PSNR of different size of images when denoised with proposed denoising algorithm

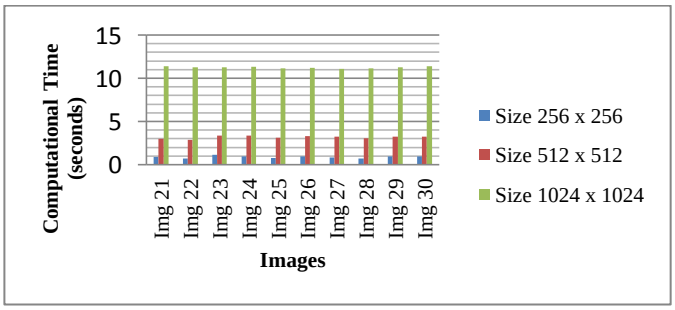

Fig. 5 Bar Graph indicating the Computational time of proposed denoising algorithm for different size of images

Table I. Comparison of Conventional NLM filter with the Proposed Denoising Algorithm in terms of PSNR, MSE and Normalized Cross correlation, Image size 512 x 512 and Noise Variance =10.

Images (512 x 512)	PSNR		MSE		Normalized Cross Correlation	
	NLM filter	Proposed method	NLM filter	Proposed Method	NLM filter	Proposed Method
Image 1	79.0096	93.6217	8.1681e-04	2.8243e-05	0.9891	0.9950
Image 2	79.6434	80.1981	7.0645e-04	6.21 e-04	0.9946	0.9961
Image 3	81.3644	82.1131	4.7494e-04	3.99973 e-04	0.9941	0.9938
Image 4	82.0552	82.8070	4.0510e-04	3.4070e-4	0.9863	0.9905
Image 5	82.0552	82.8070	4.0510 e-04	3.4070e-04	0.9975	0.9980
Image 6	81.8075	82.4385	4.2887 e-04	3.7088e-04	0.9891	0.9898
Image 7	80.3225	81.0048	6.0372 e-04	5.1594-04	0.9985	0.9986
Image 8	84.5061	85.0261	2.3033 e-04	2.0439e-04	0.9965	0.9969
Image 9	85.8232	86.1274	1.7012e-04	1.5862e-04	0.9985	0.9990
Image 10	83.4250	83.9690	2.9551e-04	2.6072e-04	0.9988	0.9990

V. CONCLUSION

In this paper a simple yet effective image denoising technique is proposed using the two most commonly used filters. Fast non Local means algorithm is used in combination with wavelet thresholding to denoise digital images. However popular these techniques may be individually there were some inherent flaws in them. By combining these filters those flaws are suppressed and a better and strong denoising mechanism is developed. It takes less processing time and gives an output with high PSNR and better visual quality. The noisy image is first subjected to the Fast NLM filter which removes maximum noise along with some image details, then wavelet thresholding restores the image details by extracting the lost content from the method noise of Fast NLM filter.

Natural images are chosen for evaluating the proposed technique. A comparative analysis of denoising techniques on the basis of evaluation parameters like MSE, PSNR, Normalized cross correlation and Computational time is done. The proposed method is tested on images of different sizes thus giving a clear idea about the dependence of processing time on the size of image. Irrespective of the image size, noise content the proposed algorithm gives a consistent output with all the image details and edges preserved.

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