Denoising Technique Using TRIMMED Bilateral Filtering Method

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Abstract - *This paper work presents a trimmed median filter bilateral algorithm for the removal of impulse noise has been proposed with color images by separation red- green-blue plane of color image. This proposed algorithm shows better results than the Standard Median Filter (MF), Decision Based Algorithm (DBA), Adaptive Median Filter (AMF) , Hybrid Filter Based Algorithm (HMF), and Trimmed Median Filter (TMF). The performance of the system is analyzed in conditions of Mean square error (MSE), Peak signal to noise ratio (PSNR) image enhancement factor (IEF) and time required for executing the algorithms for different noise density.*

Key Words: **Image Processing, Noisng Technique, Denoising, Median filter**.

1. INTRODUCTION

Various techniques have been developed to suppress noise and enhance image quality such as linear filters, nonlinear filters and wavelet threshold-based techniques. Almost all the techniques developed so far do not effort to diminish the effects of multiple noises. Hence, numerous hybrid techniques have been proposed to upturn visual quality of a received image by eliminating multiple noises [1] [2].
These digital images can be easily degraded by noise due to analog-to-digital conversion errors and faulty pixel elements in the camera sensors. Presence of noise significantly reduces the image quality and in many cases it increases the difficulty in successive processing. It is very important to remove noise in the images before ensuing processing, such as image segmentation, object recognition, and edge detection. However subtraction of noise from given noisy image is not an easy job at all, it is because images may be dishonored by different types of noise [3].

1.1 Noising Techniques

Real images are often degraded by some random errors this degradation is called noise. Image noise is the random deviation of brightness or color information in images created by the antenna and circuitry of a scanner or digital camera. The achievement or transmission of digital images in real world is often inhibited by different kinds of noise. The occurred noise may be Gaussian noise, Impulse noise, Rayleigh noise, Gamma noise, exponential noise, speckle noise, etc. The spatial property of a noise is that it is autonomous of spatial co-ordinates and uncorrelated with image itself. The presence of noise gives an image grainy, mottled, textured, or snowy appearance.

Some of the techniques apply simple filters, such as max filters, average filters, median filters, alpha-trimmed mean filters and Gaussian filters for image de-noising. These filters reduce noise at the cost of smoothing the image and moving the edge pixels. One of the widely used denoising techniques is a linear filtering technique, in which a ruined image is complex with constant matrix or kernel, which fails when the noise is non-additive. Any more type of denoising technique uses non-linear filtering techniques which are rich and controlling methods applied over corrupted noisy gray scale or color images to offer noise free image. One of the widely used non-linear techniques is Median filters based approaches, in which measures blurs the image if kernel size is increased, while removing the noise [5].

1.1.1 Impulsive Noise

Impulsive noise can be caused by malfunctioning camera photo sensors, optic imperfections, electronic instability of the image signal, aging of storage material, faulty memory locations in hardware or transmission errors due to natural or man-made processes.
Common sources of impulsive noise include also lightning, strong electromagnetic interferences caused by faulty insulations of the high-voltage power lines, car starters, and unprotected electric switches. These types of noise sources generate short time duration, high-energy pulses which disturb the regular signal, resulting in the acquisition of color image samples vary significantly from their local neighborhood in the image domain [6].

Pictorial Representation of Noise:

Types of additive noises are able to be estimated by a selected flat region of the input image. The salt and pepper noise is easily eliminated in the flat region by using a median filter because this noise type has two pick values in the near minimum and maximum intensities of the input image [6].

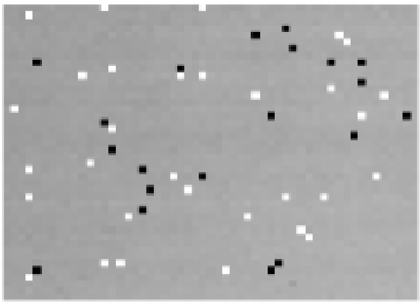


Fig -1: Pictorial Representation of Noise

2. DENOISING TECHNIQUES

One of the most fundamental processes in image processing is image denoising. The aim of image denoising is remove noise from an image without destroying object boundaries. There are mainly two noise models: additive Gaussian noise and impulsive noise which can represent the most of noises captured [7]. As mobile phone camera is widely applied in actual life because of its convenience, people's requirement of it is becoming higher and higher. Image denoising algorithm has always been a hotspot in the field of image processing. To improve the quality of mobile image, the edge of the image shouldn't be blurred while denoising [8]. Multispectral / hyper spectral images are often noisy in many situations because sensors have narrower spectral sensitivity functions and thus capture less light than normal RGB imaging devices. Whereas various applications, such as classification, target detection, spectral unmixing, and change detection need detailed and accurate spectral information, the noise due to, for example, thermal electronics and dark current, unavoidably contaminates the image acquisition process, which disrupts detailed spectral information and furthermore degrades its performance in the listed applications. Thus, denoising the images is a crucial phase in the preprocessing steps of these applications. It is effective for image denoising methods to exploit inter-channel correlation as well as spatial correlation. Unlike channel-by-channel methods that tend to produce an imbalance of colors, nowadays many smoothing and denoising methods take inter-channel correlation into account to avoid color deterioration [9].

2.1 Median Filters

Median filter having the good denoising power has been the most popular filter. Its variations have been proposed in different type of median filter, median filter based on homogeneity information decision based trimmed median filters to improve its performance [9].
Various types of median filter can be defined as:

2.2 Vector Median Filter

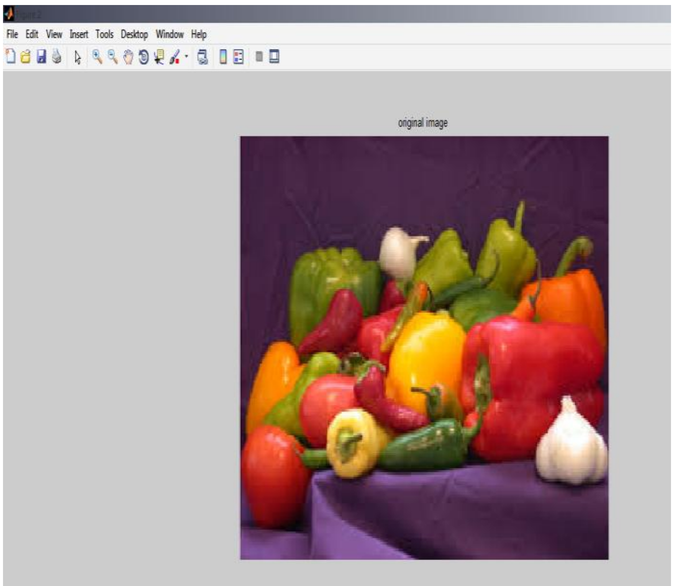
One of the most popular methods based on cheap ordering, used in many filtering designs, is the Vector Median Filter (VMF). The VMF output is the pixel from W for which the calculation of cumulated distance to other samples is minimized. It is all the time one of the pixels of the filtering window, which is money-making as the filter does not introduce any new colors to the process image. But, when all pixels of W are pretentious, for example by additional Gaussian noise, the output is also noisy. Many solutions devoted to the elimination of this undesired behavior were introduced, resulting in considerably better filtering performance. To increase the VMF efficiency, weights are assigned to the distances between pixels, which opportunity the central pixel of the filtering window, thus falling the number of unnecessarily altered pixels [7].

3. PURPOSED ALGORITHMIC DESIGN

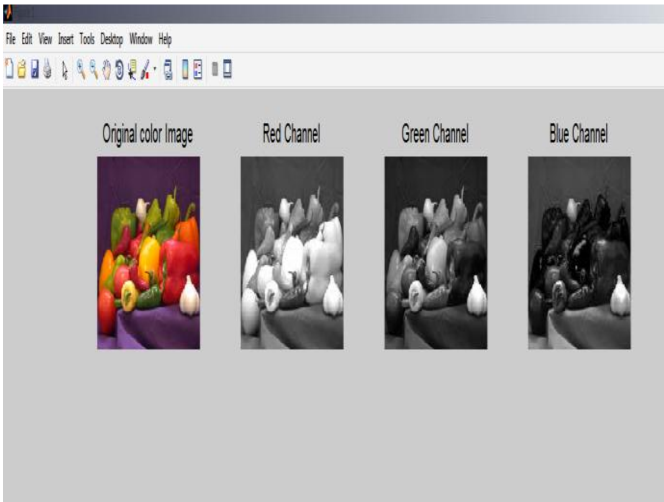
1. Read color noise image.
2. Distinct the three plane of color of color image red-green-blue plane.
3. Select any of the planes(R/G/B).
4. Select 2-D window of size 3×3. Suppose that the pixel being processed is P_{ij}.
5. If the giving out pixel has values either greater than 0 and less than 255 i.e. $0<P_{ij}<255$ then P_{ij} is an unaffected pixel and its value is left unaffected.
6. If $P_{ij}=0$ or $P_{ij}=255$ then it is a corrupted pixel and further proceeding is based on following conditions
7. Case i): If the selected window comprises all the elements as 0's and 255's. Then replace with the mean of the element of window.
8. Case ii): If the selected window comprises not all elements as 0's and 255's. Then eliminate 255 and 0's and find the average value of the remaining elements. Replace with the median value.
9. Repeat steps 4 to 6 until all the pixels in the full plane are processed.
10. Go to step 3 and Select next plane.
11. Restored all three de noise plane.

4. SIMULATION RESULTS

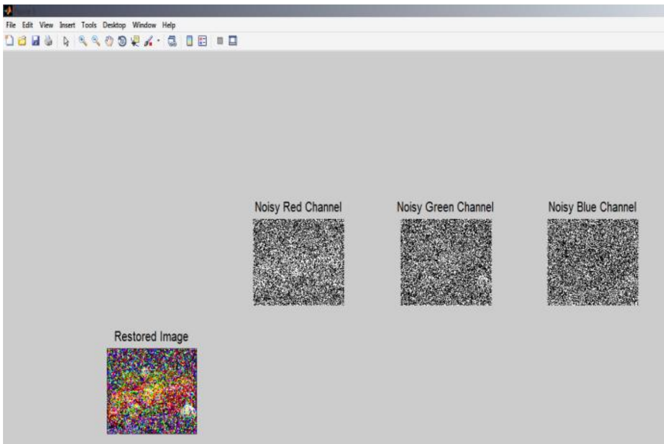
The Original Color Image is Peppers use Salt & Pepper noise and De-noised image using Median filter, Trimmed filter, Adaptive Filter, Hybrid Filter, Decision based algorithm, Trimmed Mean Adaptive Switching Bilateral Filter comparisons among them. With image matrices like PSNR, IEF, MSE.
Step1 Load the original color image.



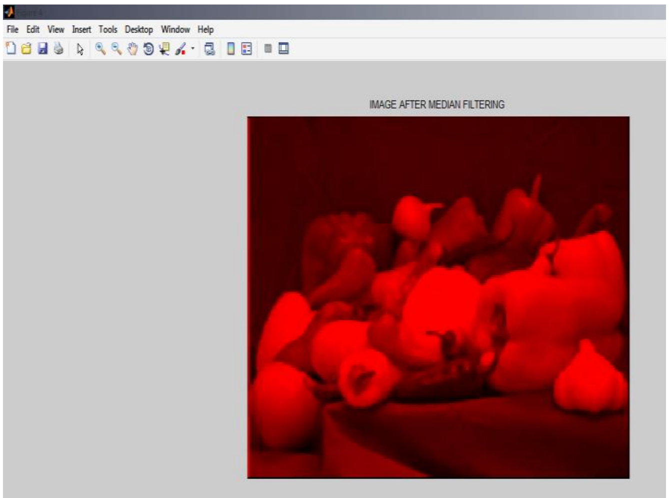
Step 2 Separate the three plane of color of color image i.e. red-green-blue plane.



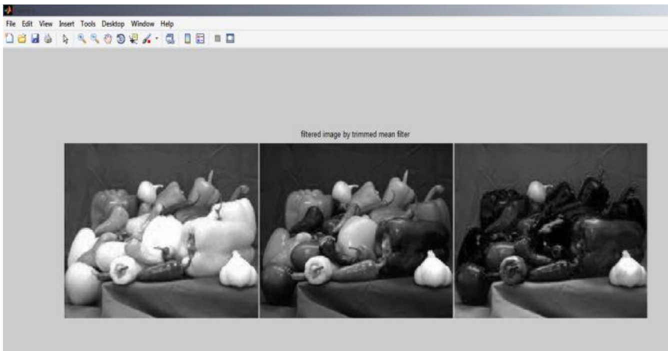
Step 3 Load the Distorted gray scale image Peepers of at the nose density level 0.9, we may include this density level 0.1 to 0.9.



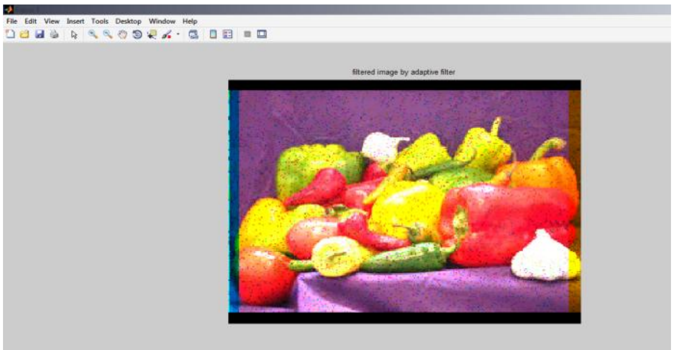
Step 4 Filtered image by Median Filter



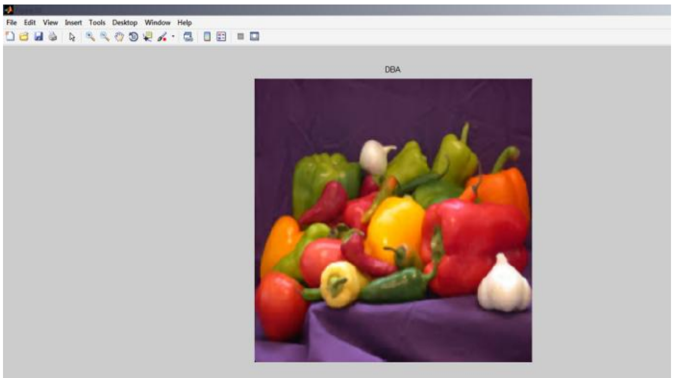
Step 5 Filtered image by Trimmed Filter



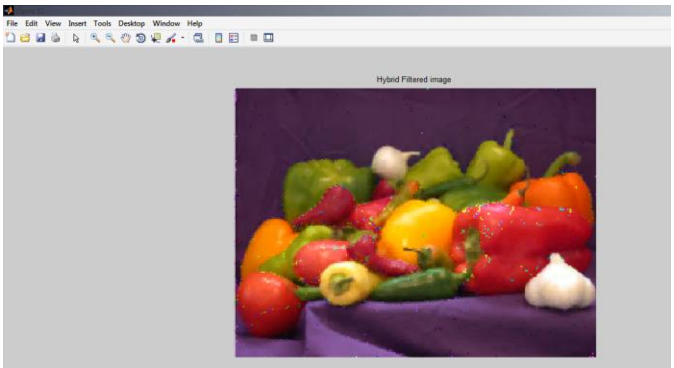
Step 6 Filtered image by Adaptive Filter



Step 7 Filtered image by DBA Filter



Step 8 Filtered image by Hybrid Filter



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Step 9 Filtered image by Purposed Filter

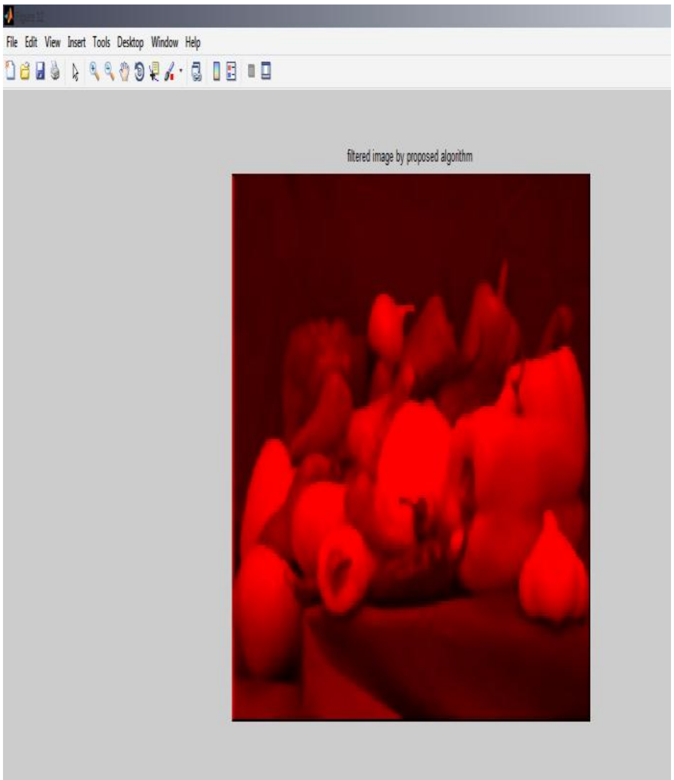


Table -1: Comparative analysis of Image Metric parameter (PSNR) using different filter

Density level	PSNR by Adaptive filter	PSNR by Hybrid filter	PSNR by conventional filter	PSNR by Trimmed filter	PSNR by DBA Filter	PSNR by Purposed Filter
0.9	5.3442	5.8275	7.7313	15.7821	18.3642	30.4421
0.8	5.3006	5.8192	9.0932	19.7079	20.6720	35.4012
0.7	5.5521	5.8278	11.9220	22.6392	24.2185	38.4220
0.6	5.8079	5.6932	14.2016	25.8731	26.7232	40.4625
0.3	5.1563	5.6594	22.6231	37.6734	38.4532	46.8550
0.1	5.2356	6.1023	28.5356	41.2341	42.5123	47.5412

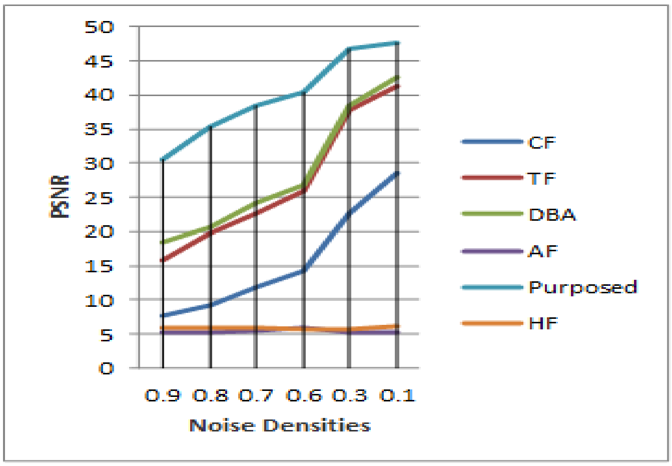


Chart -1: Comparison between PSNR and Noise Densities

Density level	IEF by Adaptive filter	IEF by Hybrid filter	IEF by conventional filter	IEF by Trimmed filter	IEF by DBA Filter	IEF by Purposed Filter
0.9	0.8391	1.006	1.4908	9.8285	12.7687	230.1087
0.8	0.8395	1.121	1.6433	21.182	31.8550	232.1754
0.7	0.7118	1.311	2.4545	43.8782	65.1478	234.1712
0.6	0.6256	1.451	3.5547	73.1846	99.6078	234.7925
0.3	0.7651	1.5321	19.3214	300.5621	342.4531	584.5631
0.1	0.1673	1.7564	26.8754	462.3421	523.2356	662.3276

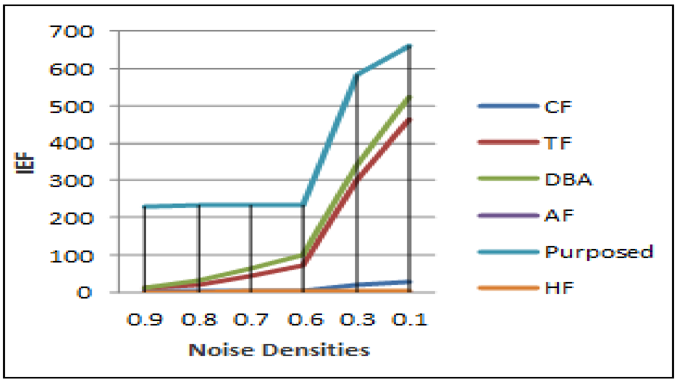
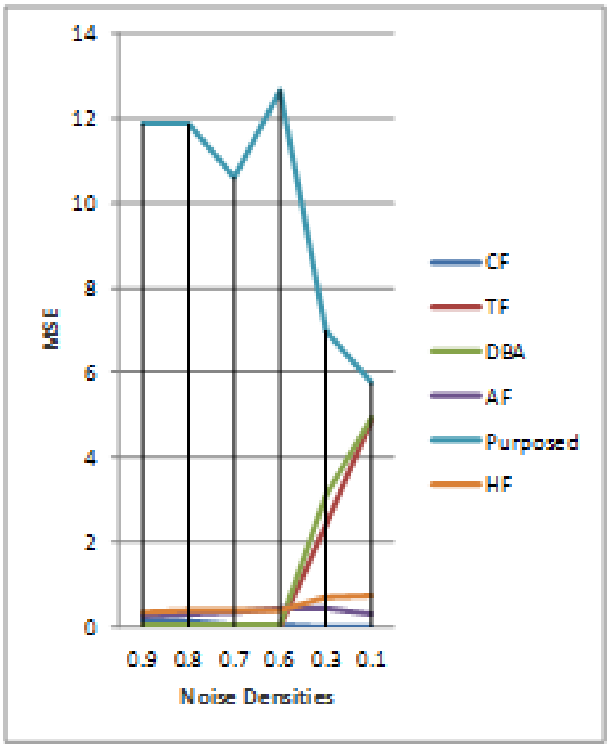


Chart -2: Comparison between IEF and Noise Densities

Density level	MSE by Adaptive filter	MSE by Hybrid filter	MSE by conventional filter	MSE by Trimmed filter	MSE by DBA Filter	MSE by Purposed Filter
0.9	0.2641	0.3563	0.1522	0.0158	0.0193	11.8734
0.8	0.2771	0.3771	0.1312	0.0366	0.0167	11.8887
0.7	0.3332	0.3865	0.0209	0.0421	0.0222	10.5962
0.6	0.4232	0.3896	0.0178	0.0119	0.0419	12.6756
0.3	0.4423	0.6953	0.0132	2.4102	3.1121	6.9945
0.1	0.2786	0.7453	0.0123	4.9048	4.9241	5.7512



5. CONCLUSION

The performance of the algorithm is tested against colour images at low, medium and high densities, showing the effectiveness how impulse noise is removed through the colour images. It yields better results than existing methods even at very high noise densities of 80% and 90%. both visual and quantitative results are also demonstrated. The performance of the algorithm is compared with that of SMF, AF, HF, DBA, and TMF in terms of Peak Signal-to-Noise Ratio Mean Square Error.

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