© 2016 IJEDR | Volume 4, Issue 3 | ISSN: 2321-9939

Removal of High Density Salt and Peppers Noise and Edge Preservation in Color Image Through Trimmed Mean Adaptive Switching Bilateral Filter

Surabhi, Neha Pawar

Research Scholar, Assistant Professor
Computer Science & Engineering Department,
Swami Devi Dyal Institute of Engineering & Technology, Barwala, India

---

***Abstract* - This paper work presents efficient Trimmed Mean Adaptive Switching Bilateral Filter algorithms for the removal of impulse noise has been proposed with color images by separation red- green- blue plane of color image. The performance of the system is analyze in provisions of Mean square error (MSE), Peak signal to noise ratio (PSNR), Image enhancement factor (IEF) and time required for executing filtering for different noise densities. Simulation results shows that proposed algorithm outperforms the existing algorithms still at high noise densities for color images. Many experiments are conduct to authenticate efficiency of the proposed algorithm and the performance of the proposed filter with respect to noise removal is better than the existing filters.**

***Keywords* - Digital Image Processing, Image Denoising, Filtering.**

I. Introduction

Digital images are indivisible parts of many applications. Acquirement [1] processing, and transmission of images, especially when carry out in cost-effective ways, generate unwanted artifacts. For example, digital images in use by consumer digital cameras endure from thermal sensor noise, demo sacking noise and quantization noise. The problem of image denoising (noise reduction) is one of the oldest in the field, and is still receiving considerable concentration from the research area because of ever-increasing demand for reasonably priced high-quality media as well as its role as a pre-processing step for image segmentation, compression, etc. Due to high spatial being without a job of natural images, local averaging of the pixels considerably reduce the noise while preserve the original structure of the image.

Noise reduction [2] in digital images, despite many years active research, still remains a challenging problem. The fast proliferation of portable image capturing devices, combined with the smallness of the imaging sensors and increasing data throughput capacity of communication channels, consequences in the need to create novel fast and efficient denoising algorithms. Color images are very often corrupted by precipitate noise, which is introduced into the image by faulty pixels in the camera sensors, transmit errors in noisy channels, poor lighting conditions and aging of the storage material**.**

II. Image Noise

Image noise is usually an aspect of electronic noise [8] which causes an image to have random variation in brightness or color in sequence. Presence of noise reduces the ability of observer in analyzing the image. In general the image noise model is measured as follows:

$$g(x, y) = f(x, y) + \eta(x, y) \qquad (1)$$

where $f(x, y)$ is the original image pixel, $\eta(x, y)$ is the noise time and $g(x, y)$ is the resultant noisy pixel. There are many different models for the image noise term $\eta(x, y)$, in holder of Gaussian noise, $\eta(x, y)$ has its probability density function equal to that of the normal distribution.

III. Denoising

Denoising of an image refers [9] to the removal of noise from the observed image and is often used as a pre-processing step before accepting and analysis of the image scene can take place.. Anisotropic diffusion is one of the most popular non-linear filtering methods, uses neighboring conduction coefficients of the gra- dient scale function allowing it to preserve as well as sharpen the edges. It is a slowly converging non-linear iterative procedure, and may consequence in a piecewise smoothed version of the image. While the over- sharpening and slow convergence issues may have largely been defeat by works such as regularized and robust anisotropic diffusion leftovers ill-suited for denoising of images containing textured pattern.

IV. Image Filtering

4.1 Adaptive Filtering

Adaptive Median [3] is a “decision-based” or “switching” filter with the reason of first identifies possible noisy pixels and then replaces them using the median filter or its variants, though leaving all other pixels unaffected. This filter is good at detecting noise even at a far above the ground noise level. The adaptive structure of this filter ensures with the intention of most of the impulse noises are detected even at a far above the ground noise level provided with the purpose of the window size is big enough. The performance of AMF is good at subordinate noise density levels, due to the fact that here are only fewer corrupted pixels that are replaced through the median values. At higher noise densities, the number of replacements of dishonored pixel increases significantly; increasing window size will provide better noise removal performance; however, the dishonored pixel values and replaced median pixel values are less connected. The adaptive median filter (AMF) adopts adaptive window size and performs well at low noise density, but the filter window size has to be expanded when the noise density increases which may lead to blurring the image. To avoid the damages of noise-free pixels, the switching median filters are introduced somewhere impulse detection algorithms are employed before filtering and the detection outcome are used to control whether a pixel should be modified. It is difficult to define a robust threshold and also these filters will not take into version the local features as a result of which details and edges may not be recovered satisfactorily.

4.2 Median Filtering

Median filters [4] are especially appropriate for reducing "salt & pepper" noise. Median filter is a spatial filtering operation, which uses a 2-D mask that is applied to each pixel in the input image. Median filtering preserves spiky edges, whereas linear low-pass filtering blurs such edges. Median filters are very resourceful for smoothing of spiky noise. Median filter often blur the image for larger casement size and inadequate noise suppression for small window sizes. Median filters are recognized for their capability to take away impulse noise without damaging the edges. Median filters are known for their capability to remove impulse noise as well as conserve the edges. The main disadvantage of a standard median filter [4] is that it is effective only for small noise densities. At high noise densities, SMFs frequently exhibit blurring for large casement sizes and inadequate noise repression for small window sizes. However, most of the median filters work uniformly across the image and thus tend to adapt both noise and noise-free pixels. Consequently, the efficient removal of impulse often leads to images with distorted and distorted features. Ideally, the filtering should be useful only to corrupted pixels while send-off uncorrupted pixels intact. Applying median filter absolutely across the entire image as practiced in the conventional scheme would unavoidably alter the intensities and remove the signal details of uncorrupted pixels.

4.3 Trimmed Median Filter

Trimmed Mean Filtering (TMF) is a symmetrical filter [5] where the trimming is symmetric at moreover end. In this procedure, even the uncorrupted pixels are also trimmed. This lead to defeat of image details and blur of the image. In this TMF, the selected 3x 3 window elements are arranged in moreover increasing or decreasing order. Then the pixel values 0’s and 255’s in the representation (i.e., the pixel values dependable for the salt and pepper noise) are removed from the image. Then the median value of the outstanding pixels is taken. This median value is used to restore the noisy pixel. This filter is called trimmed median filter since the pixel values 0’s and 255’s are removed from the selected window. This process removes noise in better way than the ATMF.

4.4 Hybrid Filtering

Noise is the most annoying problem [6] in image processing. One method to get rid of this difficulty is the development of such a robust algorithm that can perform the dealing out tasks in presence of noise. The other way is to plan a filtration process to eliminate the noise from images while preserving its features, edges and details. Noise introduces random variation into image that changes the original values to some dissimilar values. Causes which may introduce noise to images include flaws in data transmission, flawed optics, sensor malfunctioning, processing techniques and electronic interference .Mathematical morphology is a methodology mainly calculated for the investigation of geometrical structure in an image by inquiring it with small patterns called structuring elements. The resultant image operators are nonlinear and found useful for several applications like edge detection object segmentation, noise suppression and exploring geometrical structures of images. Alternate sequence filters (ASFs) are documented as one of these significant operators and have been widely used and researched. Some other morphological filters include multi organization elements based morphological filters soft morphological filters and hybrid operator based morphological filters.

4.5 Bilateral filtering

Bilateral filtering is another non-linear filtering method [7] which is able regard as an extended version of the lowpass Gaussian filtering. In real meaning, it is a easy combination of a domain filter, comparable to the Gaussian filter, and a range filter which is a Gaussian function of restricted intensity differences. The major idea is that only perceptually analogous colors are averaged jointly to avoid unforeseen color combination in images. Barash unified anisotropic diffusion and non-linear bilateral filtering as another efficient edge preserving filtering technique. However, one of the major limitations of bilateral filtering is that the variety filter coefficients rely heavily on real pixel intensity values, as it does not take into account any local characteristics, which may in turn have been partial by noise therefore potentially resulting in smoothed textured regions.

4.6 DBA

The corrupted pixels are restore by also the median pixel or neighborhood pixel in difference to AMF and other existing algorithms that make use of only median values for replacement of corrupted pixels.[14] At upper noise densities, the median value may also be a noisy pixel in which case district pixels are used for replacement; this provides upper correlation between the corrupted pixel and neighborhood pixel. Higher correlation gives rise to better edge preservation. In addition, the DBA uses simple fixed length window of size 3*3.

V. SIMULATION RESULTS

The Original Color Image Leena 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.

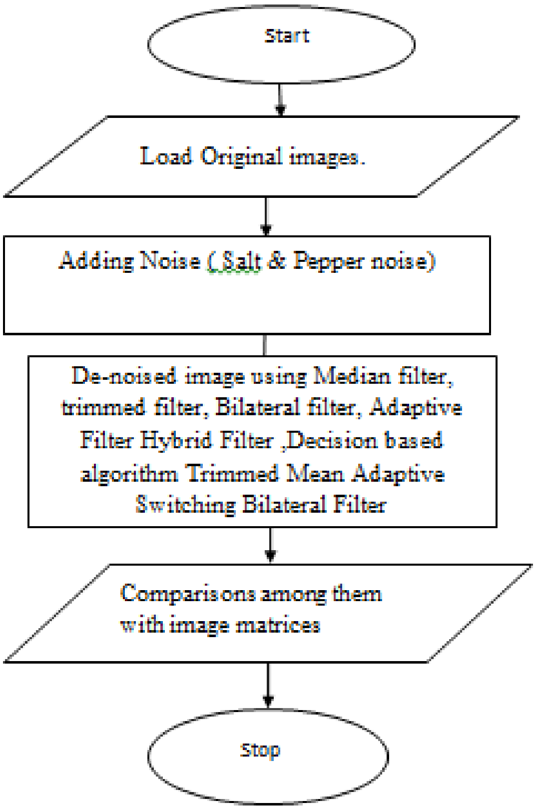

Fig.5.1 Flowchart of the Methodology Adopted

5.1 Load the Original and Distorted Images

Firstly we load the original and distorted images to analyse the quality of distorted images by taking original images as reference. The images used are as follows:

Step 1: Load the original color image

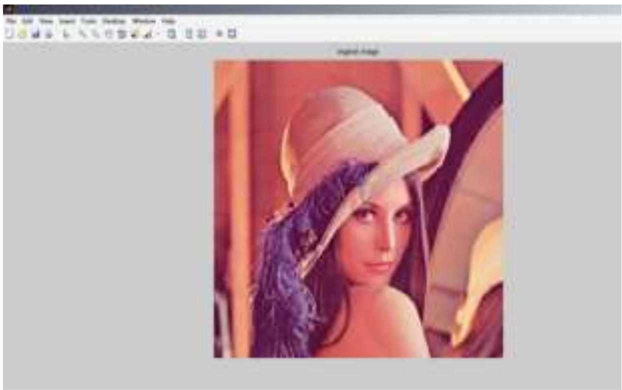

Fig. 5.2 Original Image of Leena

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

Fig. 5.3 three plane of color Image of Leena

Step 3: Load the Distorted color image Leena at the nose density level 0.9, we may include this density level 0.1 to 0.9. In this work we use the maximum density level of noise, through which we easily check the performance of the filters, and also calculate the image matrices like PSNR, IEF, MSE.

Fig. 5.4 Distorted Image of Leena at density level 0.9

Step 4: Filtered image by Median Filter

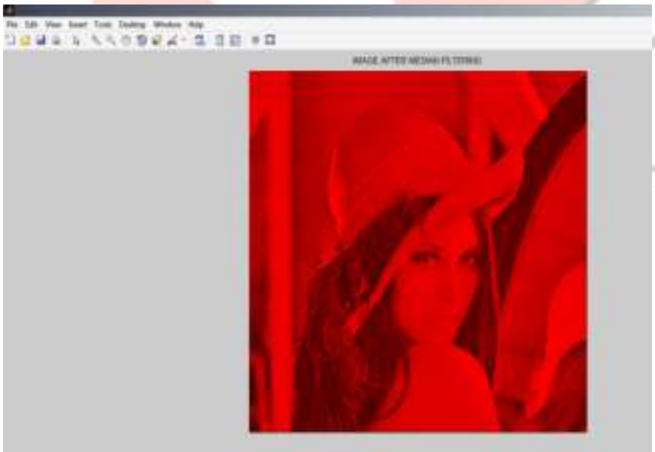

Fig. 5.5 Filtered image by Median filter Leena

Step 5: Filtered image by Trimmed Filter

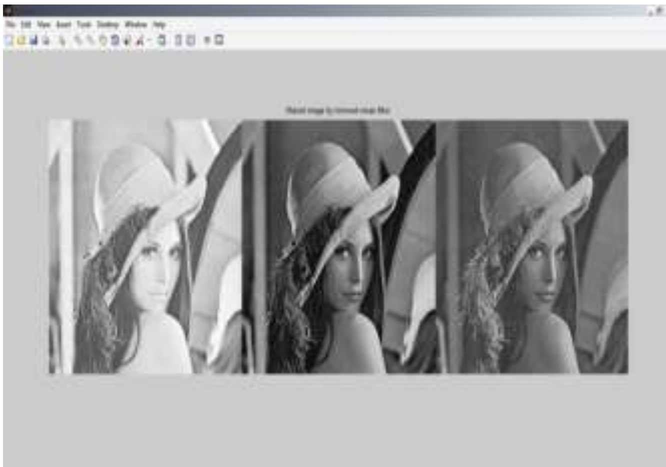

Fig. 5.6 Filtered image by Trimmed Filter Leena

Step 6: filtered image by Adaptive Filter

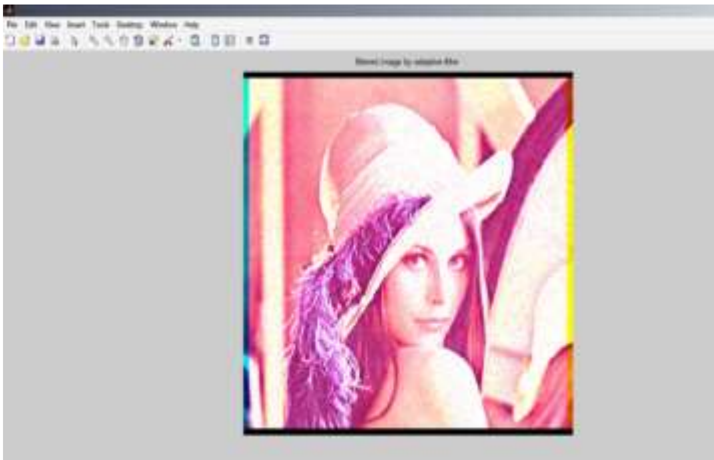

Fig. 5.7 Filtered image by Adaptive Filter Leena

Step 7: filtered image by DBA Filter

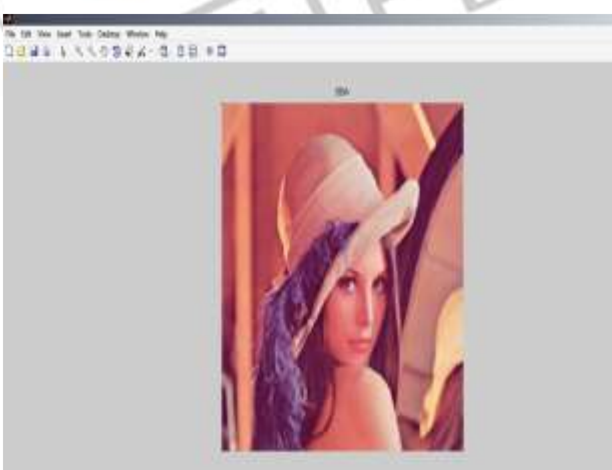

Fig. 5.8 Filtered image by DBA Filter Leena

Step 8: Filtered image by Hybrid Filter

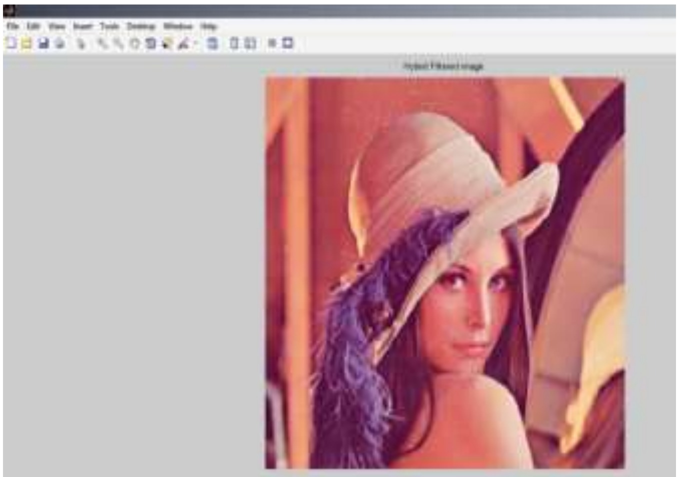

Fig. 5.9 Filtered image by Hybrid Filter Leena

Step 9: Filtered image by Proposed Filter

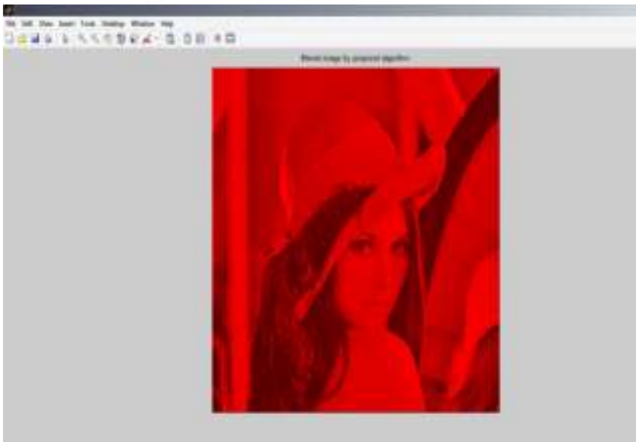

Fig. 5.10 Filtered image by Proposed Filter Leena

Table No-5.1 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 Proposed Filter
0.9	5.2441	5.8040	7.6490	15.9578	12.6202	17.4590
0.8	5.3004	5.9001	9.1402	20.2768	19.5619	22.2818
0.7	5.3006	5.1001	11.0223	24.6545	24.2003	26.9577
0.6	5.3001	5.1201	9.0980	20.1420	28.5819	30.3712
0.3	5.2123	5.8294	23.8836	36.5829	38.1330	34.0134
0.1	5.4223	6.0023	29.4894	42.8393	45.7571	35.1481

As shown in Table 5.1, PSNR value of different algorithms is compared with the proposed algorithm as a function of noise density for color lena image. Table shows that the proposed algorithm (TMASBF) outperforms the existing algorithms for noise densities from 0.1 to 0.9 A plot of PSNR values has been presented in Fig.5.11

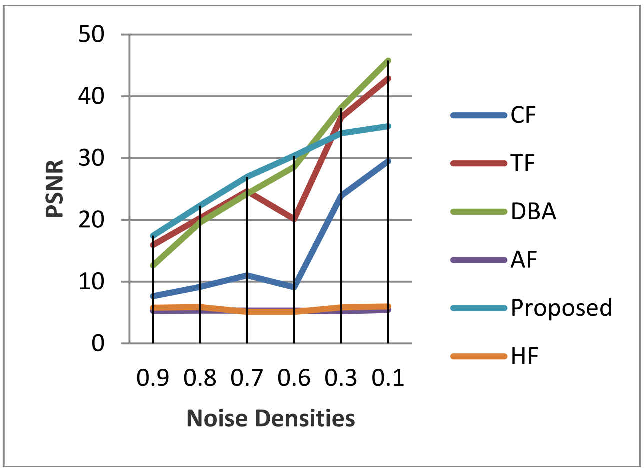

Fig. 5.11 PSNR By leena

Table No-5.2 Comparative analysis of Image Metric parameter (IEF) using different filter

Density level	IEF by Adaptive filter	IEF by Hybrid filter	IEF by conventional filter	IEF by Trimmed filter	IEF by DBA Filter	IEF by Proposed Filter
0.9	0.8588	1.000	1.4984	10.0868	14.2333	14.3170
0.8	0.7625	1.004	1.8704	23.9377	28.8894	38.6670
0.7	0.2951	1.115	2.5268	58.4271	96.4340	98.4535
0.6	0.5743	1.221	3.6916	130.8048	38.6670	186.8449
0.3	0.2867	1.4532	19.8471	120.4534	140.4657	385.6745
0.1	0.0950	1.6543	25.6134	591.8261	592.3421	595.3432

Table 5.2 shows comparison of Image Enhancement factor of different algorithms for color image at different noise densities (0.1 to 0.9). In comparison with the existing algorithms, the proposed algorithms shows substantial growth in IEF values even at high noise density. From Fig.5.12 it is clear that, at low noise density, this algorithm outperforms the existing ones having high IEF Values.

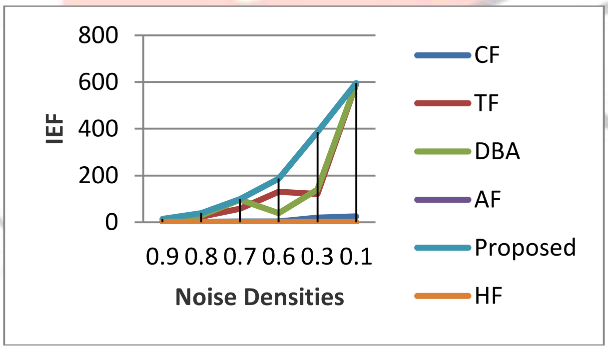

Fig. 5.12 IEF By leena

Table No-5.3Comparative analysis of Image Metric parameter (MSE) using different filter

Density level	MSE by Adaptive filter	MSE by Hybrid filter	MSE by conventional filter	MSE by Trimmed filter	MSE by DBA Filter	MSE by Proposed Filter
0.9	0.2989	0.3846	0.1713	0.0255	0.0005	0.0177
0.8	0.2787	0.5672	0.1219	0.0095	0.0007	0.0058
0.7	0.6764	0.6778	0.0790	0.0034	0.0020	0.0020
0.6	0.5653	0.6882	0.0471	0.0013	8.0013	9.4417
0.3	0.2989	0.6983	0.0043	2.1928	2.2346	3.0010
0.1	0.2345	0.7054	0.0011	4.8101	4.9000	4.9012

Table 5.3 shows the mean square error comparison of different algorithms as a function of noise density for leena image. Here as the noise density varied from 0.1 to 0.9 i.e. even at high noise density the proposed algorithm shows minimum MSE values, showing the effectiveness of proposed algorithm.

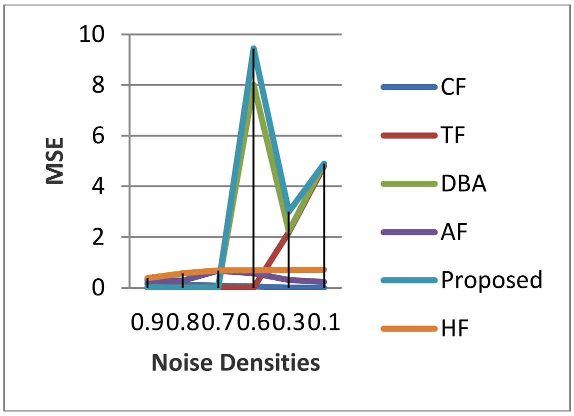

Fig. 5.13 MSE Leena By Different Filter.

VI. CONCLUSION

In this paper work I have proposed a new algorithm for the removal of impulse noise from the color images. This new algorithm is named as Trimmed Mean Adaptive Switching Bilateral Filter (TMASBF). The purposed filter is capable of removing very high density impulse noise from images and it also preserves the important details of image during denoising. However the time required executing this algorithm is bit more than the existing algorithms .The performance of the algorithm is tested against colour images at low, medium and high densities, showing the usefulness how impulse noise is removed through the colour images.

VII. REFERENCES

[1]Mehdi Teimouri, Ehsan Vahedi, Alireza Nasiri Avanaki, "An Efficient Denoising Method For Color Images" 1-4244-0779-6/07/$20.00 ©2007 IEEE.
[2]Malini.S "Image Denoising Using Multiresolution Singular value Decomposition Transform" International Conference on Information and Communication Technologies (ICICT 2015)pp;1708-1715.
[3]K.Aiswarya,V.Jayaraj,D.Ebenezer "A New Switching-Based Median Filtering Scheme and Algorithm for Removal of High Density Salt and Pepper Noise in Images" 2010 Second International Conference on Computer Modeling and Simulation pp;409-413.
[4]Yanyan Wei, Shi Yan, Ling Yang "An Improved Median Filter for Removing Extensive Salt and Pepper Noise"2014 International Conference on Mechatronics and Control (ICMC) July 3 - 5, 2014, Jinzhou, China pp;897-901.
[5]S. Esakkirajan, T. Veerakumar "Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median Filter" IEEE SIGNAL PROCESSING LETTERS, VOL. 18, NO. 5, MAY 2011 pp;287-290.
[6]Isma Irum" A Nonlinear Hybrid Filter for Salt & Pepper Noise Removal from Color Images" Comsats Institute of Information Technology Vol.13,February 2015 pp;79-86.
[7]Nasir Rajpoot "A multiresolution framework for local similarity based image denoising" Sciverse Science Direct (2012) pp;2938–2951.
[8]Mayank Tiwari "Image Denoising using Spatial Gradient Based Bilateral Filter and Minimum Mean Square Error Filtering"Eleventh International Multi-Conference on Information Processing-2015 (IMCIP-2015) pp; 638 – 645.
[9]Nasir Rajpoot "A multiresolution framework for local similarity based image denoising" Sciverse Science Direct (2012) pp;2938–2951.
[10]Dr.T. Santhanam , Ms.K.Chithra "A new decision based unsymmetric trimmed median filter using euclidean distance measure for removal of high density salt and pepper noise from images" ICICES2014 - S.A.Engineering College, Chennai, Tamil Nadu, India.
[11]Mr.N.Krishna Chaitanya1, Mr.P.Sreenivasulu2" Removal of Salt and Pepper Noise Using AdvancedModified Decision Based Unsymmetric Trimmed Median Filter" 20141ntemational Conference on Electronics and Communication System (fCECS -2014.
[12] Mahdi Nooshyar, Mohamad Momeny" Removal of high density impulse noise using a novel decision based adaptive weighted and trimmed median filter" 2013 8th Iranian Conference on Machine Vision and Image Processing (MVIP).
[13] Lukasz Malinsk• Bogdan Smolka "Fast averaging peer group filter for the impulsive noise removal in color images" J Real-Time Image Proc. Springer May 2015.
[14]K. S. Srinivasan and D. Ebenezer, "A new fast and efficient based algorithm for removal of high density impulse noise," *IEEESignal Process. Lett.*, vol. 14, no. 3, pp. 189–192, Mar. 2007.

Author's Profiles

Er.Surabhi is from Panchkula. Born on 26 December 1990. She completed B.Tech CSE from Swami Devi Dyal Institute of Engineering, Barwala, India in the year 2012. She is pursuing M.Tech (Computer Science) from SDDIET, Barwala, India.

Er.Neha Pawar is from Ambala City. She completed her B.Tech in 2008 and M.Tech in 2011. Er. Neha Pawar has teaching experience of five years.