Comparative Analysis of Various Median Filters Using Peak Signal TO Noise Ratio (PSNR)

S. Saranya, K. Shanthi

Abstract—**Image Processing and Image Enhancement play a vital role in numerous applications. The image enhancement technique is to improve the interpretability and the visual appearance of an image or to provide better input for other automated image processing techniques. Image enhancement techniques enhance the visibility of any portion or feature of the image by suppressing the unwanted information. The objective is to increase the image quality by removing blurring and noise. The restorations of grayscale and color images are highly corrupted by impulse noise. The proposed work compares the modified non-linear filter algorithm with other existing algorithms such as Adaptive Median Filter (AMF), Decision Based Median Filter (DBMF), Switching Median Filter (SMF), Modified Decision Based Median Filter (MDBMF). The proposed algorithm considers different grayscale and color images. It is based on the parameters such as Peak Signal-to-Noise Ratio (PSNR) and Mean Square Error (MSE). The modified non-linear filter is used to enhance the image effectively which is used in further image processing operations.**

Keywords: Peak Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE), Decision Based Median Filter (DBA), Adaptive Median Filter (AMF), Switching Median Filter (SMF).

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I. INTRODUCTION

In recent years, image enhancement of the image is to provide a better transform representation for future automated image processing, such as analysis, detection, segmentation and recognition [1]. The image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified. Digital Image enhancement techniques provide a multitude of choices for improving the visual quality of images. Image enhancement is a purely subjective processing technique. This means that the required result varied from person to person. The enhancement process does not increase the inherent information content in the data. Mostly Images are corrupted by impulse noise. There are two common types of impulse noise, salt-and-pepper noise random-valued noise [8]. The salt and pepper noise appear as sprinkling of white and black

dots on the gray scale image. The salt and pepper noise corrupted pixels of image take either maximum or minimum pixel value. Random value noise can be considered as pixels that are degraded to any random value within the dynamic range of the gray scale image. For impulse noise removal by certain switching schemes like adaptive vector median filter (AVMF) with a switching scheme, fast peer group filter (FPGF) [14] and vector lower-upper-middle smoother (VLUM) to decrease the number of misclassified pixels.

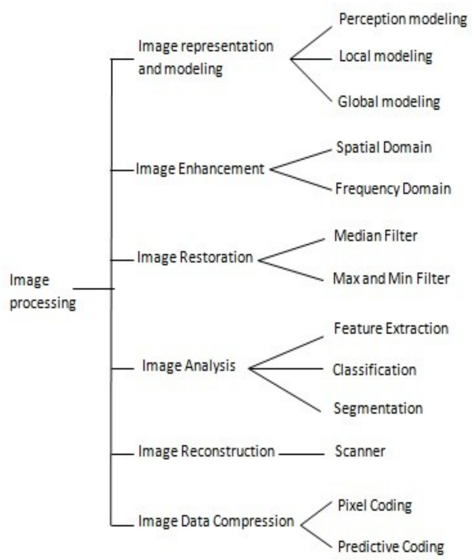

Fig 1.1 Approaches of Image Processing

II. LITERATURE SURVEY

There are various filters like adaptive median filter, switching median filter, decision based median filter and modified decision based median filter. Many authors used all these filters to reduce the values.

A Noisy Dim Image Using Curvelet and Morphology [2], the curvelet transform is based on multi scale ridgelets. Ridgelets will have global length and variable width.The morphological filters such as opening by reconstruction and closing by reconstruction. Finally, Gamma correction is used to evaluate the bright dark regions and to maintain bright regions as in the original image.

I. Suneetha and T. Venkateswarlu [4] Visual inspection of objective results shows that PGI method has a smaller mean

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square error and computational complexity when compared to THE and AHE methods. The detection accuracy is measured using the parameters like miss detection ratio and undetected ratio [8]. The noisy pixels which are detected by the morphological noisy detector filter can be considered as the holes in the image which need to be inpainted by using the KSVD algorithm. For these images Lena, Horses, Mushroom, Barbara, Boat and Deer, PSNR and MSE values are calculated in [8]. Comparative study of various noise [11] and denoising filters is discussed. In decision based filter [9], replacing the noisy pixel value of the median value in its neighbourhood only if the median comes from a noise free pixel. It applies a robust estimator to smoothen the filtered output.

But to strengthen the output of filters the SMF, the AMF, the DBA, the NAFSMF, and the MDBUTMF in [9]. NAFSM filter [10] is able to suppress high-density of salt-and pepper noise, at the same time preserving fine image details, edges and textures, computational efficiency of the filter is also implemented. Modified algorithm [12] prevents the smoothing of edges in the noise removal process, by predicting the possible edges and taking the mean value of the predicted edge. This algorithm has three steps noisy pixel detection, replacement of noisy pixels, confirmation by comparing with a threshold. A two-phase noise detector is used for noise reduction in modified switching median filter. The two phases are

- Adaptive vector median filter detection method to identify pixels that are likely to have been corrupted by noise

- Noise candidates are judged by using four one-dimensional Laplacian operators, which allow edge pixels to be preserved

III. PROPOSED WORK

The proposed work of this paper is to compare the adaptive median filter (AMF), progressive switching median filter (PSMF), decision based median filter (DBA), modified decision based median filter (MDBA) with the modified non linear filter (MNF). A performance of these filters is calculated using peak signal noise ratio (PSNR) and mean square error (MSE). The architecture diagram of the image restoration follows the noisy image as the input and the output will be denoised image. Image restoration of the proposed architecture as:

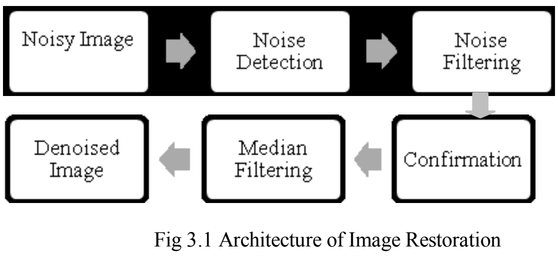

Fig 3.1 Architecture of Image Restoration

A. Adaptive Median Filter

The Adaptive Median Filter classifies pixels as noise by comparing each pixel in the image to its surrounding neighbour pixels. A pixel that is different from a majority of its neighbours, as well as being not structurally aligned with those pixels to which it is similar, is labelled as impulse noise. These noise pixels are then replaced by the median pixel value of the pixels in the neighbourhood that have passed the noise labelling test.

B. Switching Median Filter

In switching median filter, the difference between the median value of pixels in the filtering window and the current pixel value is compared with a threshold to determine the presence of impulse. There are three stages of switching-based median filtering, namely, noise detection, estimation of noise-free pixels and replacement. The principle of identifying noisy pixels and processing only noisy pixels has been effective in reducing processing time as well as image degradation. A Switching Median Filter with Boundary Discriminative Noise Detection for Extremely Corrupted Images. This technique is proficient in eliminating high densities of impulse noise as well as preserving the edges and fine details.

C. Modified Non linear Filter

The Modified Non-linear Filter algorithm processes the corrupted images by first detecting the noisy pixels in the image. Only corrupted pixels are processed to replace with noise free pixel value, uncorrupted pixels are left unchanged. Each and every pixel of the image is processed for checking salt and pepper noise. Different cases are illustrated in this section.

Case i): If the processing pixel is not noisy pixel contains all values in between minimum and maximum grey level values then processing pixel is not changed.

Case ii): If the processing pixel is noisy and even few neighbor pixels are noisy not all:

$$\begin{bmatrix} 78 & 90 & 0 \\ 120 & 0 & 255 \\ 97 & 255 & 73 \end{bmatrix}$$

Where “0” is processing pixel. Now eliminate the corrupted pixels from window. That is eliminating 0’s and 255’s from window. Remaining pixels are [78 90 120 97 73]. Here median value is 90. Hence it is replaced with processing pixel.

Case iii): If the selected window contains processing pixel noisy and also all the window elements are 0’s and 255’s.

$$\begin{bmatrix} 0 & 255 & 0 \\ 0 & 255 & 255 \\ 255 & 0 & 255 \end{bmatrix}$$

Then two steps are drawn

Step i): Increase the window size if maximum window limit has not reached. This again draws the following cases.

Case 1): After increasing if window not having all 0’s and 255’s.

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$$\begin{bmatrix} 0 & 255 & 0 & 80 \\ 0 & 255 & 255 & 255 \\ 255 & 0 & 255 & 150 \\ 120 & 60 & 30 & 40 \end{bmatrix}$$

Then remove pixels with 0's and 255's and that results [80 150 120 60 30 40]. Find the mean of these pixels results 80. This is replaced in processing pixel.

Case 2): After increasing if window contains all 0's and 255 then follow step i.

Step ii): If maximum window size limit is reached and even then window has all 0's and 255's then find mean of all elements. Replace this value with processing pixel value. This is followed for each and every pixel in image.

For these filters PSNR and MSE values are calculated, PSNR and MSE can be defined as:

The PSNR block computes the peak signal to noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image.

$$PSNR = 10\log_{10}\frac{255^2}{MSE} \qquad (1)$$

The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error.

$$MSE = \sum_i \sum_j \frac{(X(i,j) - Y(i,j))^2}{MXN} \qquad (2)$$

Where M x N is the size of the image, X represents the original image, Y denotes the de-noised image, (i, j) represents the processed pixel in the window size of M x N.

IV. EXPERIMENTAL RESULTS

The input image that is given to the system may contain noise. To get a clear image that can be used for other image processing, noise in the image has to be removed. Noise can be removed after detecting the noise and filtering it. The output image that has undergone filtering process is a denoised image.

Fig 4.1 Input Image

All the three filters is executed in matlab. Noise density is calculated for [10, 20, 30, 40, 50, 60, 70, 80, 90] in percentage. For the 50th percentage denoised image for the input image in figure 4.1. Figure 4.2 shows the denoised image using adaptive median filter , figure 4.3 shows the denoised image using switching median filter, figure 4.4 shows the denoised image using decision based median filter.

With these three filters decision based median filter is recognised as the best filter comparing the values of peak signal noise ratio and mean square error.

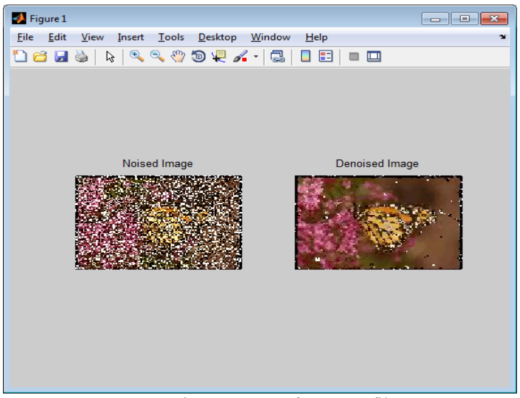

Fig 4.2 Image for AMF filter

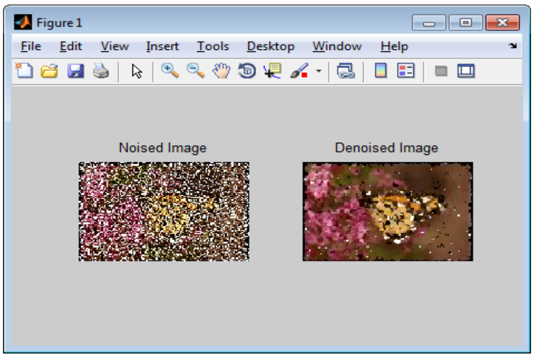

Fig 4.3 Image for SMF filter

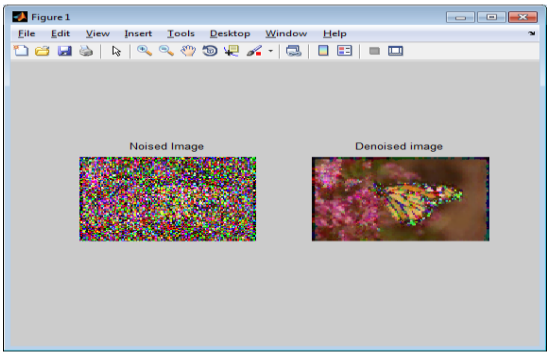

Fig 4.4 Image for DBA filter

Peak signal noise ratio and mean square error is displayed in matlab using above formulas. PSNR and MSE values are shown in the figure 4.5 for adaptive median filter, figure 4.6 for switching median filter, figure 4.7 for decision based median filter.

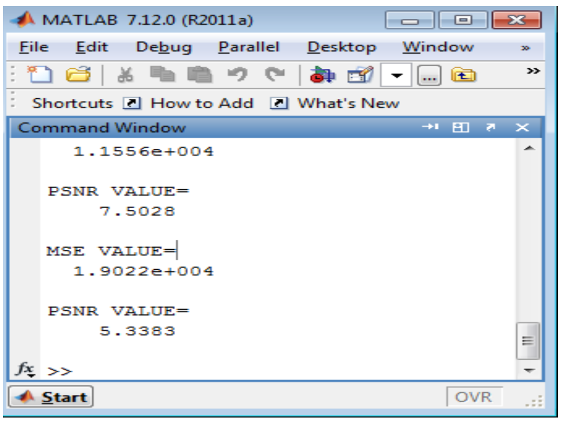

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Fig 4.5 values for AMF filter

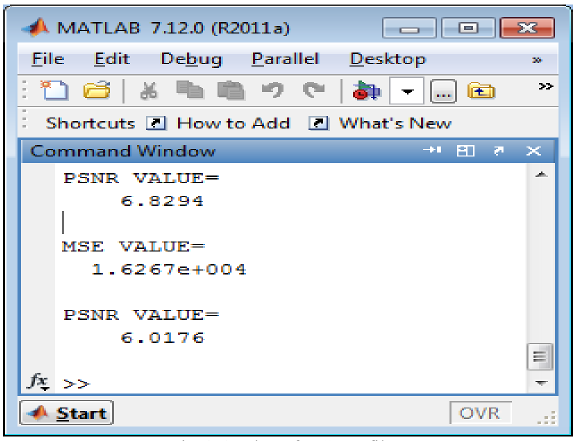

Fig 4.6 values for SMF filter

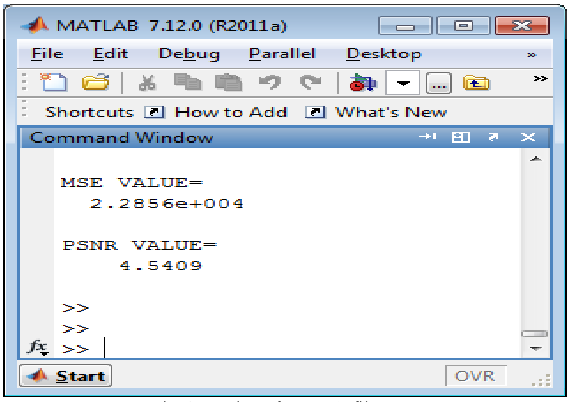

Fig 4.7 values for DBA filter

Graph is plotted for PSNR in decibels vs. noise density in percentage. Noise density values are [10 20 30 40 50 60 70 80 90]. Adaptive median filter graph is shown in figure 4.8, switching median filter graph is shown in figure 4.9, decision based median filter graph is shown in figure 4.10.

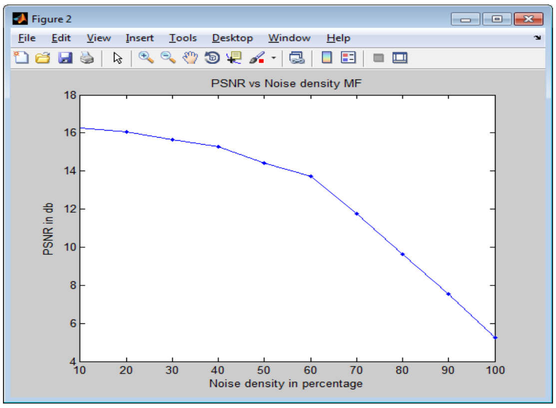

Fig 4.8 Graph for AMF filter

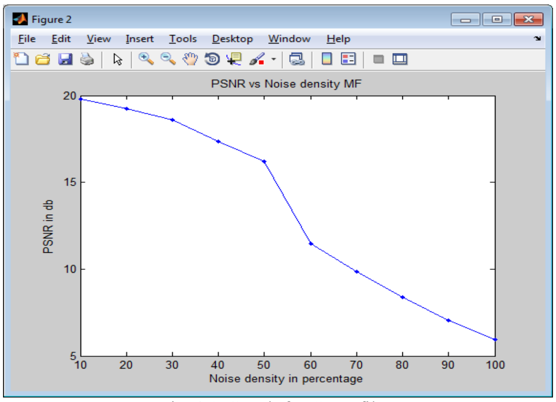

Fig 4.9 Graph for SMF filter

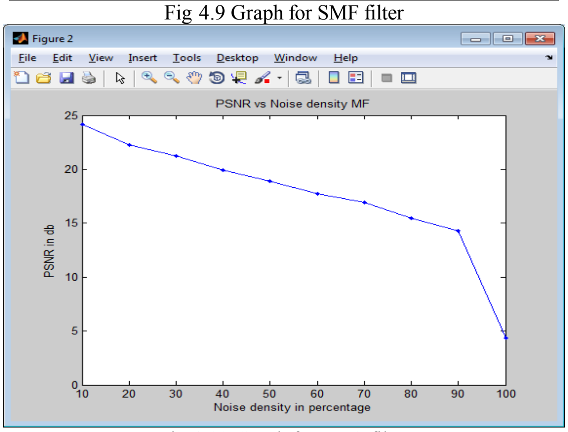

Fig 4.10 Graph for DBA filter

V. CONCLUSION

By implementing the AMF, SMF and DBA filters for a noisy image, it is inferred that the decision based filter has less PSNR value for the noisy image in the matlab. But Modified decision based median filter (MDBA) can comparatively and quantitatively gives better performance than the existing filters. The future work is to apply modified non linear filter (MNF) for the filter.

REFERENCES

[1] S.S. Bedi, Rati Khandelwal, "*Various Image Enhancement Techniques*", International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 3, March 2013,pp 1605 – 1609

[2] Yenduri Naveen and Sumana Gupta, "*Removal of Salt and Pepper Noise Using Sparse Representation*", Eighth International Conference on Signal Image Technology and Internet Based Systems, IEEE 2012, pp 58-63.

[3] Muthu Selvi Roselin and Dr.Kavitha, "*A Hybrid Image Enhancement Technique for Noisy Dim Images Using Curvelet and Morphology*", International Journal of Engineering Science and Technology Vol. 2(7), 2010, pp 2997-3002

[4] I. Suneetha , T. Venkateswarlu, "*Binary Image Enhancement Technique Using PSI Model For Contrast Improvement In Spatial Domain*", International Journal of Electronics and Communication Engineering (IJECE) Vol. 2, Issue 2, May 2013, pp 9-18

[5] S. Esakkirajan, T. Veerakumar, Adabala N. Subramanyam, and C. H. PremChand "*Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median*

ISSN: 2278 – 7798

Filter" IEEE signal processing letters, vol. 18, no. 5, may 2011, pp 287-290

[6] Muhammad Mizanur Rahmani, M. Abdullah-AI-Wadud and Chrysanthe Prezal "*A Decision based Filter for Removing Salt and Pepper Noise*" IEEE/OSA/IAPR International Conference on Infonnatics, Electronics & Vision, IEEE 2012, pp 1064-1068

[7] Kenny Kal Vin Toh and Nor Ashidi Mat Isa, "*Noise Adaptive Fuzzy Switching Median Filter for Salt-and-Pepper Noise Reduction*", IEEE signal processing letters, vol. 17, no. 3, march 2010,pp 281-284

[8] Venkatasubramanian Adhinarayanan, S.P.Sheebha, L. Sriraman, T. N. Prabakar, G. Seetharaman, "*A Modified algorithm for Removal of Salt and Pepper Noise in Color Images*", Third International Conference on Intelligent Systems Modelling and Simulation, IEEE 2012, pp 356-361

[9] Gaihua Wang, DehuaLi , WeiminPan , ZhaoxiangZang, "*Modified switching median filter for impulse noise removal*", Signal Processing Elsevier May 2010 , pp 3213–3218

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