International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 02 | Feb 2021 www.irjet.net p-ISSN: 2395-0072

Removal of Salt and Pepper Noise in Images by using Improved Median Filter

Nikita Sharma[1], Naveen Dhillon[2]

[1]M.Tech Scholar in R.I.E.T, Phagwara
[2]Principal in R.I.E.T, Phagwara

Abstract - *It is an enhanced decision based algorithm where noise pixels are detected in several phases based on predefined threshold value. The noise pixels are replaced by median, where median value is calculated without considering pixel value. As a result, at high density noise environment it is very efficient to find noise free median value. The algorithm initially select filtering window for processing corrupted pixel. When all the elements in the window are corrupted, the processing pixel is replaced by noise free last processed pixel. If the last processed pixel is 0 or 255 then the algorithm will create a filtering window with a new dimension to identify pure black and white region of the image. Experiments exhibit better result at filtering window. In this stage a standard median filtering approach is applied to determine probable intensity value. If the median value is noise pixel then the algorithm will calculate the mean value of all elements in the window. After that, robust estimation algorithm is applied to the proposed filter to remove discontinuity of pixel intensity and smooth the restored image. Experimental result shows that it can provide very high quality restored images, when the noise density is large. In this research, a modified decision based median filtering approach is presented for the restoration of gray scale and color images that are highly corrupted by salt and pepper noise. The proposed Improved Median Filter (IMF) algorithm processes the corrupted image by first detecting the salt and pepper noise. The processing pixel is checked whether it is noisy or noise free. If the processing pixel is lies between maximum and minimum gray level values then it is noise free pixel, it is left unchanged. If the processing pixel takes the maximum or minimum gray level then it is noisy pixel which is processed by IMF. Experimental results show that the proposed algorithm achieved not only high PSNR but also pleasure visual results even when the noise level is very high.*

Key Words: **PSNR** and **IMF.**

1. INTRODUCTION

The field of image processing focuses on automating the process of gathering and processing visual information. The process of receiving and analyzing visual information by digital computer is called digital image processing. Digital image processing may be classified into various sub branches based on methods whose input and output are images and inputs may be images whereas outputs are attributes extracted from those images[1]. Various image processing functions based on the above two classes are Image Acquisition, Image Enhancement, Image Restoration, Color Image Processing, Multi-resolution Processing, Compression, Morphological Processing, Segmentation, Representation and Description and Object Recognition.

Noise is undesired information that contaminates the image. In other words, noise is a random, usually unwanted, fluctuation of pixel values which is introduced into images mainly during transmission and/or acquisition. In the image denoising process, information about the type of noise present in the original image plays a significant role[2]. Typical images are corrupted with noise modelled with both a Gaussian, uniform, or salt and pepper distribution.

a. **GAUSSIAN NOISE: -** In Digital Image Processing Gaussian Noise can be reduced using a spatial filter. As the name indicates, this type of noise has a Gaussian distribution, which has a bell shaped probability distribution.
b. **RAYLEIGH NOISE:-**A Rayleigh distribution is often observed when the overall magnitude of a vector is related to its directional components[3]. One example where the Rayleigh distribution naturally arises is when wind velocity is analysed in two dimensions.
c. **Salt and Pepper Noise : -** is a form of noise sometimes seen on images. It is also known as impulse noise. This noise can be caused by sharp and sudden disturbances in the image signal. It presents itself as sparsely occurring white and black pixels. An effective noise reduction method for this type of noise is a median filter or a morphological filter Median Filtering is highly effective in removing salt and pepper noise[4].

1.1 Filters in Image processing :

a. **Standard Median Filter (SMF):-**The Standard Median Filter is a simple basic rank selection filter, used to remove impulse noise by changing the brightness of the central pixel of the filtering window with the median of the brightness of the pixels contained within the window. To overcome the Mean and Median filters the SMF filter is introduced [5].
b. **Super Mean Filter (SUMF):-**Super mean filter (SUMF) removes high density salt and pepper noise from digital images. The SUMF filter works in two stages, first stage

identifies noisy pixels and second stage removes noisy pixels [6]. To identify the noisy pixel and noise free pixels, identification is based on the two intensities that present the impulse noise are the maximum and the minimum values of the image dynamic range.

c. **Weighted Median Filter (WMF):** Weighted median filter is a median filter introduced by Justusson in 1981, has been employed in a wide range of computer vision solutions for its beneficial properties in sparsity representation. But it is hard to be accelerated due to the spatially varying weight and the median property.

d. **Mean-Median Filter**
Mean - Median Filter is a combination of sample mean and sample median. The images are corrupted with various levels of impulse noise ratio. The significant difference in mean square error (MSE) and Peak signal to noise ratio (PSNR) with other mean and median filters quantifies the superiority of the Mean - Median filter[7]. From the analysis it is very clear that Mean – Median Filter performs well on low level impulse noise levels to very high level impulse noise levels. Median filters are known for their capability to remove impulse noise as well as preserve the edges.

2. LITERATURE SURVEY :

Lalit Kumar Baghel et al in year 2020: Formation of image is affected by image capturing device characteristics and intensity of light. Therefore inferior quality of image capturing device and inadequate lighting conceals particulars and significant details associated with image. In order to squeeze out the hidden features, image enhancement (noise removal) is mandatory. Hence noise removal is realized as pre-processing step in image study. In this research paper a Decision Based Hybrid Median Filter is suggested for the renovation of gray scale images corrupted by fixed valued Impulse noise.

Hong-Yao Den Get al in year 2020: A Modified PM Diffusion Method is proposed for salt-and-pepper noise removal. In contrast to original PM method, there are two crucial differences. Firstly, the modified method only treats noisy pixels in an image domain, rather than all pixels, and thus is suitable for images not only with low noise but also with high noise. Secondly, the modified PM method implements diffusion operations along eight-neighbors directions, rather than along four-neighbors directions, and thus can reconstruct more details from noisy images.

Lianghan Hu et al in year 2019: Non-uniform Partition (NUP) and Directional Weighted Mean Filter (DWMF) are both effective salt and pepper denoising algorithms than many other common denoising algorithms, but some defects are still existing in the situation of high noise density thus reducing their denoising performance. In this paper, a novel salt and pepper denoising algorithm, Non uniform Weighted Mean Partition, based on NUP and DWMF is proposed.

Kohei Inoue et al in year 2019: Two methods for removing high density salt-and-pepper noise in images have been proposed by Esakkirajan et al. and Hong et al. However, their methods have not been yet compared experimentally. In this paper, we compare them and show some experimental results. Additionally, we propose a hybrid method which is derived by combining the two methods, and experimentally show that the proposed method achieves higher values of both peak signal-to-noise ratio (PSNR) and image enhancement factor (IEF) than the two methods.

Syamala Jayasree P et al in year 2018: The accuracy of a proper Biometric Identification and Authentication Systems depends on the image quality to arrive at a reliable and accuracy result. To get a noise-free fingerprint image, they are subjected to preprocessing and filtering tasks. In this paper, we propose a faster and an efficient way to remove salt and pepper impulse noise and also the edge preserving regularization of the henceforth obtained fingerprint noise free image using B-Sp lines.

Cheng-Hsiung Hsieh et al in year 2018: In this paper, apply the one-dimensional polynomial interpolation to salt and pepper noise removal. The difference between the proposed approach and median based schemes is that the noise pixel is replaced by an interpolated value instead of median in the window. With window, two non-noise neighbor pixels are used to estimate the noise pixel by first-order PI. Then the interpolated value takes the place of noise pixel.

3. RESEARCH METHODOLOGY:

In this research present a method to remove salt-and-pepper noise for single images. The method consists of two stages, noise detection and noise removal. In the first stage, a detector identifies corrupted pixels, in the second stage, an algorithm employs a nonlinear isotropic diffusion to suppression noise, which diffusion is only for those corrupted pixels. We apply our method to a test set containing five images. Experimental results show that the method is powerful for salt-and-pepper noise removal. In this research, a Improved decision based median filtering approach is presented for the restoration of gray scale and color images that are highly corrupted by salt and pepper noise.

It is an enhanced decision based algorithm where noise pixels are detected in several phases based on predefined threshold value. The noise pixels are replaced by median where median value is calculated without considering 0 and 255. As a result, at high density noise environment it is very efficient to find noise free median value. The algorithm initially select 3X3 filtering window for processing corrupted pixel. When all the elements in the window are corrupted, the processing pixel is replaced by noise free last processed pixel. If the last processed pixel is 0 or 255 then the

algorithm will create a filtering window with a new dimension to identify pure black and white region of the image. Experiments exhibit better result at 9X9 filtering window.

In this stage a standard median filtering approach is applied to determine probable intensity value. If the median value is noise pixel then the algorithm will calculate the mean value of all elements in the window. After that, robust estimation algorithm is applied to the proposed filter to remove discontinuity of pixel intensity and smooth the restored image. Experimental result shows that it can provide very high quality restored images, when the noise density is large.

The objectives of research are followings:

1. To analysis the results of proposed method with conventional median filters.
2. To reduce high density salt and pepper noise from images and restore the lost information without distorting the edges.
3. To improve the quality of image based on the PSNR, MSE and MAE values.

4. EXPERIMENTAL RESULTS

The performance of the proposed improved median filter and conventional median filters were analyzed for different noise density (ND) of salt and pepper noise added to gray level images. The threshold was varied to obtain maximum PSNR, MSE and MAE.

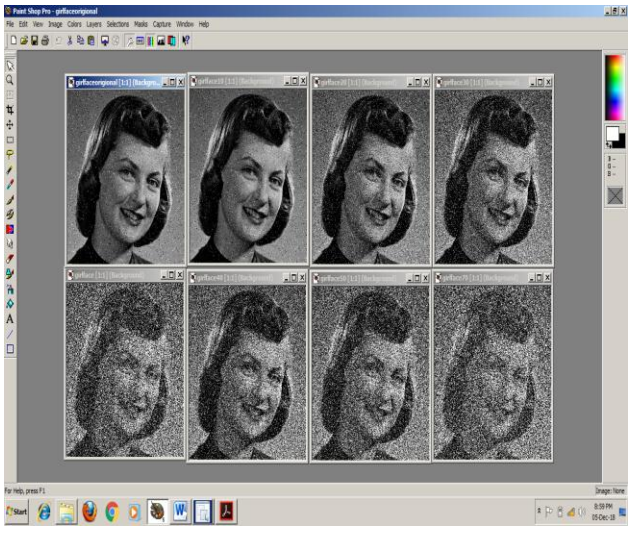

Fig -1 Illustrates noisy images for 10%, 20%,30%,40%,50% noise densities along with their filtered images and the original image of girl face.

Table -1: Comparison of PSNR values on girl face.

Noise Density	IMF (Proposed Algorithm)	MF	IDBHMF (Base paper)	AMF
10	11.08	6.31	12.25	4.92
20	10.91	6.3	12.29	4.94
30	10.91	6.31	12.78	4.98
40	10.97	6.36	12.99	5.07
50	11.2	6.42	12.58	5.17

Table -2 Comparison of MSE values on girl face.

Noise Density	IMF (Proposed Algorithm)	MF	IDBHMF (Base paper)	AMF
10	5060.15	15199.96	3872.43	20935.73
20	5267.19	15212.95	3829.83	20824.15
30	5269.93	15177.37	3427.01	20619.05
40	5194.93	15023.22	3266.45	20217.36
50	4925.35	14818.6	3584.58	19742.32

Table -3 Comparison of MAE values on girl face image.

Noise Density	IMF (Proposed Algorithm)	MF	IDBHMF (Base paper)	AMF
10	42.85	117.38	28.73	140.56
20	44.49	116.7	27.16	139.33
30	44.68	115.65	23.67	137.4
40	44.33	114.01	22.09	134.62
50	42.62	112.19	23.5	131.49

5. CONCLUSIONS

The performance of the algorithm for various images at different noise levels is studied. Results are shown in tables 1 to 3. The first column represents the output of proposed filter Improved Median Filter (IMF), second column represent output of the Standard Median filter (SMF) , third column represent the output of Median Decision Based Algorithm (IDBHMF) and fourth column represent output of the Adaptive Median Filter(AMF).

This algorithms gives best results with increasing PSNR value and reducing the error rate. In this way we get high quality images by restoring the images and restoring the lost information, which can be very beneficial for a number of areas like security field, medical field, and digital field. This can be wide research area.

Some of the additional enhancement would be to employ the projected algorithm in several previous filtering algorithms with reduce the subtraction time and with other technique for better result. To join the features of Mean and Median noise removal filters. To employ previous noise removal algorithms similar to Gaussian noise, shot noise, Quantization noise (uniform noise) anisotropic noise and Periodic noise.

REFERENCES

[1] Lalit Kumar Baghel , Ramesh Kumar Sunkaria "Dr. B. R. Ambedkar National Institute of Technology Jalandhar, India" High Density Fixed Valued Impulse Noise Removal Using Improved Decision Based Hybrid Median Filter and its Application on Medical Images", IEEE 2018.

[2] Hong-Yao Deng, Qing-Xin Zhu, Xiu-Li Song, "A Nonlinear Diffusion For Salt And Pepper Noise Removal", IEEE Trans, 2016.

[3] Lianghan Hu, Kin Tak U, "Removal of Salt and Pepper Noise with Non-uniform Weighted Mean Partition", IEEE Trans, 2015.

[4] Kohei Inoue, Kenji Hara, and Kiichi Urahama, "A Hybrid Method for High Density Salt-and-Pepper Noise Removal", International Conference on Signal-Image Technology & Internet-Based Systems, 2013.

[5] Syamala Jayasree P, Pradeep Kumar, "A Fast Novel Algorithm for Salt and Pepper Impulse Noise Removal using B-Splines for Finger Print Forensic Images", IEEE Trans, 2013.

[6] Cheng-Hsiung Hsieh, Chia-Wei Lan, Pei-Wen Chen, Wei-Lung Hung, "Application of Polynomial Interpolation To Salt And Pepper Noise Removal", Proceedings of the Seventh International Conference on Machine Learning and Cybernetics, Kunming, 12-15 July 2008.

[7] Neela Chithirala, Natasha., Rubini. , Anisha Radhakrishnan, "Weighted Mean Filter for Removal of High Density Salt and Pepper Noise", 3rd International Conference on Advanced Computing and Communication Systems (*ICACCS* -2016), Jan. 22 – 23, 2016, Coimbatore, INDIA 2016.

[8] M. R. Khammar1, M. I. Saripan, "Removal of High Density Salt and Pepper Noise from Image and Video Based on Optimal Decision Based Algorithm", IEEE Trans, 2014.Syamala Jayasree P, Pradeep Kumar, "A Fast Novel Algorithm for Salt and Pepper Impulse Noise Removal using B-Splines for Finger Print Forensic Images", IEEE Trans, 2013.

[9] Ayush Kumar, Nimisha Agarwal, Juhi Bhadviya, Gaurav Mittal, Giovanni Ramponi, "An Efficient New Edge Preserving Technique for Removal of Salt and Pepper Noise", 8th International Symposium on Image and Signal Processing and Analysis (ISPA 2013).

[10] Chen Cong-ping,Wang Jian, Qin Wu, Dong Xiao-gang, "A New Adaptive Weight Algorithm for Salt and Pepper Noise Removal", IEEE Trans, 2011.