An Impressive Method to Remove High Density Salt-And-Pepper Noise from Video Image

M. Gowrishankar[1], Mr. S. Suresh Kumar[2]

PG Student, Department of ECE, Coimbatore Institute of Engineering and Technology, Narasipuram, Coimbatore[1]

Assistant Professor, Dept of ECE, Coimbatore Institute of Engineering and Technology, Narasipuram, Coimbatore[2]

Abstract: In this paper, a various noise reduction techniques to remove high density Salt and Pepper noise is presented and the importance of impulse noise removal has been studied and implemented. The effective removal of impulse noise from gray-scale image is performed by median filter and analyzed various noise reduction techniques such as Switching Median filter, Adaptive median filter, Dynamic median filter and Trimmed median filter which removes noise effectively even at high noise level and preserves the fine details and edges effectively with reduced streaking at higher noise densities and gives better performance when compared to Median filter. The above techniques works by detecting the corrupted pixels and replaced them with median value. It will remove only 0 and 255, they will be most likely replaced close approximations of their original values (i.e. 0 with 1 or 2 and 255 with 254 or 253). Different filtering techniques are applied in removing low to medium density impulse noise with detail preservation up to a noise density of 70% compared to standard median filter (MF), Switching median filter (SMF), Adaptive median filter (AMF), Dynamic Adaptive Median Filter (DAMF), Unsymmetric Median Filter (USMF), Trimmed median filter (TMF).The ITMF performs well compared to other filters and it gives better results with high PSNR.

Keywords: MATLAB; Switching median filter, Dynamic Adaptive median filter, Unsymmetric median filter, Trimmed median filter, salt & pepper noise, PSNR.

I. INTRODUCTION

A very large portion of image processing is devoted to image restoration. This includes research in algorithm development and routine goal oriented image processing. Image removal is the removal or reduction of degradations that are incurred while the image is being obtained [1].

Degradation comes from blurring as well as noise due to electronic and photometric sources. Blurring is a form of bandwidth reduction of the image caused by imperfect image formation process such as relative motion between the camera and the original scene or by an optical system that is out of focus. When aerial photographs are produced for remote sensing purposes, blurs are introduced by atmospheric turbulence, aberrations in the optical system and relative motion between camera and ground. In addition to these blurring effects, recorded image is corrupted by these noises too. A noise is introduced in the transmission medium due to noisy channel, errors during the measurement process and during the quantization of the data for digital storage [2]. Each element in the imaging chain such as lenses, films and digitizer, etc. contributes to the degradation.

II. NOISE REDUCTION TECHNIQUE

Most algorithms for converting an image sensor data into image, whether in a camera or in a computer, involve some form of noise reduction. There are many procedures for this, but all attempt to determine whether the actual difference in pixel values constitute noise or photographic detail and average out the format while attempt to preserve the better. However, no algorithm can make this perfectly, so there is s trade-off made between noise removal and preservation of fine details and the low contrast details.

Median Filter

Median filter is a special case of non-linear filter unlike mean filter. Similar to mean filter, in mean filter the pattern of neighbours is considered to be as Window or kernel, which moves, pixel by pixel over the entire image. A 3×3, 5×5 or 7×7 kernel of pixels is scanned over the entire image.

First, for the processing pixel (center pixel) the median value of the pixel value is calculated and then it is replaced with that calculated median value is called as median filter.

In similar way the median is calculated for the entire image. Median filter is processed by, first sorting the current processing pixel and neighboring pixel either in ascending or descending order.

Next the median is calculated from the sorting result. And then the center pixel is replaced with that computed median value.

Switching Median Filter

The switched median filter is similar method when compare to median filter, the only difference is the median filter modify each pixel with median of neighborhood pixels, but in switching median first it detect the processing as noisy (0 or 255)or noise free pixel [9]. If noisy then find and replace with median value otherwise it maintains the same value as the replaced value.

Adaptive Median Filter

The novel filter processing principles are based on the AMF [5]. AMF works in a rectangular kernel area, Sxy and changes (increases) the size of, Sxy during filtering operation, depending on certain conditions listed below. If the filter does find that the pixel at (x, y) is noise in the kernel center, the value of the pixel will be replaced by the median value in, Sxy.

Dynamic Adaptive Median Filter

The filter is dynamic in nature as it decides the window size for the test pixel locally before filtering during run time and is adaptive due to the selection of a proper window size. It works on two stages i.e. noise detection followed by application of DAMF to the corrupted pixels only. If the center (test) pixel in a 3 x 3 window is either 0 or 255 it is considered to be noisy. If the total number of non- noisy (healthy) neighbors is greater or equals to 3 then the test pixel is replaced with median of healthy neighbors [7]. Otherwise, the size of window in increased to 5 x 5 and the process is repeated till the window size reaches to a predefined maximum window size.

Trimmed Median Filter

Trimmed Median Filter (TMF) is a decision based unsymmetric filter. TMF is a two stage filter. First it detects the noisy pixels and then restores them [3]. TMF considers all saturated pixels (0 or 255) as noisy pixels. If a pixel value lies within the dynamic range then it is considered a noise free pixel. Noise free pixels are left unchanged in the restoration stage. For each noisy pixel, the neighboring pixels within the 3X3 window are analyzed in the restoration stage.

Case 1: If all the pixels of the selected 3X3 window are deemed to be noisy, then the center pixel is replaced by the mean of the 3X3 window in the restored image.

Case 2: If the selected 3X3 window contains both the noisy pixels and noise free pixels, then the center pixel is replaced by the median of the noise free pixels in the3X3 window.

Unsymmetric Trimmed Median Filter

This filter is also called trimmed median filter because the pixel values 0‟s and 255‟s are removed from the selected window. This procedure removes noise in better way than the ATMF. The drawback in Alpha trimmed median filter is even the uncorrupted pixels are also trimmed and it is a symmetrical filter where the trimming is symmetric at either end.

This leads to loss of image details and blurring of the image. In order to overcome this drawback, UTMF is proposed [4]. “Trimming” refers to removing the noisy pixels from the selected window in the filtering stage.

Filtering using unsymmetric trimmed median filter involves three possible cases.

Case 1: If the selected window contains all corrupted pixels, then the processing pixel is replaced by the mean value of the remaining pixels in the window.

Case 2: If the selected window contains corrupted pixel as the processing one and not all other pixels are corrupted, then we replace the corrupted pixels are removed and for the remaining elements median is calculated. The test pixel is replaced with this value.

Case 3: If the processing pixel of the selected window is a noise free pixel, then it is left unprocessed.

In this method the selected window is arranged either in ascending or descending order. Then the gray values 0‟s and 255‟s in the image (i.e., the salt and pepper noise) are removed from the image. Then the median value is calculated from the remaining pixels in the window and this median value is used to replace the noisy pixel. This filter is called trimmed median filter because it is removing noisy pixels in the image.

Iterative Trimmed Median Filter

The TMF failure scenario is handled by replacing the center pixel with the mean value of all the pixels within the selected window. This will introduce false colors (or intensities in case of grayscale images) to the center pixel due to the contribution of salt & peppers within the selected window.

In order to overcome this Drawback, an Iterative Trimmed Median Filter (ITMF) is proposed. This method considers all pixels with values 0 or 255 as noisy pixels and other pixels as image pixels.

Adaptive Window Trimmed Median Filter

The Adaptive Window Trimmed Median Filter (AWTMF) handles the TMF failure scenario by adaptively increasing the selected window size to obtain an image pixel within the selected window. There is no iteration process within the AWTMF.

When using the AWTMF, if the selected 3 X 3 window of a pixel is fully noisy, then a 5 X 5 window is selected and trimmed median filtering is applied. If the selected 5 X 5 window is also fully noisy, then a 7 X 7 window is selected and trimmed median filtering is applied and so forth.

III. SIMULATION RESULTS

The original image is House image, adding Salt & Pepper noise and De-noised image using Median Filter, Switching Median Filter, Adaptive Median Filter, Dynamic Adaptive Median Filter, Trimmed Median Filter, Unsymmetric Trimmed Median Filter, Iterative Trimmed Median Filter, and Adaptive Window Trimmed Median Filter is shown in **Fig 1** to **Fig 10** and comparisons of MSE, PSNR is given in **Table 1** and **Table 2**.

DOI 10.17148/IJIREEICE.2016.4614

Table 1.1 Comparative MSE for different filters for Gray Scale Image

ALGORITHM / IMAGE		MF	SMF	DAMF	UTMF	ITMF	AWTMF
HOUSE	ND=10%	0.1267	0.9514	0.1038	0.0960	0.1960	0.1853
	ND=20%	0.2231	0.9691	0.1990	0.1926	0.2262	0.2859
	ND=30%	0.3175	0.9674	0.2941	0.2880	0.2450	0.3841
	ND=40%	0.4088	0.9860	0.3904	0.3836	0.2836	0.4794
	ND=50%	0.4939	0.9883	0.4859	0.4757	0.3123	0.5708
	ND=60%	0.5714	0.9907	0.5852	0.5672	0.3436	0.6620
	ND=70%	0.6369	0.9977	0.6854	0.6511	0.3886	0.7791

Table 1.2 Comparative PSNR for different filters for Gray Scale Image

ALGORITHM / IMAGE		MF	SMF	DAMF	UTMF	ITMF	AWTMF
HOUSE	ND=10%	38.4740	21.2570	43.2028	40.8815	46.5787	39.7421
	ND=20%	37.6721	21.1862	42.0237	38.3371	43.2528	33.3135
	ND=30%	36.3627	21.1512	40.8635	36.6610	41.1575	32.7144
	ND=40%	34.4723	21.1521	39.6668	35.3324	39.5693	31.9854
	ND=50%	32.1779	21.2215	38.5014	34.3157	37.9774	31.3988
	ND=60%	30.0514	21.1166	37.4973	33.4698	36.4938	30.8628
	ND=70%	27.9514	21.0480	36.2328	32.6103	34.4786	30.2021

Fig 1: Original gray scale image

Fig 2: Noisy image of House

Fig 3: Noise reduction using Median filter

Fig 5: Noise reduction using Adaptive Median filter

Fig 4: Noise reduction using Switching Median filter

Fig 6: Noise reduction using Dynamic Adaptive Median filter

Fig 8: Noise reduction using Unsymmetric Trimmed Median filter

Fig 7: Noise reduction using Trimmed Median filter

Fig 9: Noise reduction using Iterative Trimmed Median filter

Fig 10: Noise reduction using Adaptive window Trimmed Median

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

IV. CONCLUSION

The importance of salt and pepper noise removal has been studied and the effective removal of salt and pepper noise in gray-scale image is performed by median filter and various noise reduction techniques such as Switching Median filter, Adaptive median filter and Trimmed median filter gives better performance when compared to Median filter. The performance of the different algorithms are compared with parameters like PSNR (Peak signal to noise ratio), and MSE (Mean Square Error) in that Iterative trimmed median filter gives the better performance than other techniques. The visual quality clearly shows the ITMF filter preserve fine details such as lines and corners satisfactorily. This filter removes salt and pepper noise effectively up to 70% compared with other algorithms.

REFERENCES

[1] Aiswarya. K, V. Jayaraj, and D. Ebenezer (2010) Athi Narayanan, G. Arumugam, Prof. Kamal Bijlani), "A new and efficient algorithm for the removal of high density salt and pepper noise in images and videos," in Second Int. Conf. Computer Modeling and simulations,pp. 409-413.

[2] Alagesan.R, Mrs.M.A.P.Manimekalai (2013)"An Impressive Method to Remove High Density Salt-And-Pepper Noise from Microarray Image", International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)Volume 2, Issue 3, March 2013.

[3] Athi Narayanan, G. Arumugam, Prof. Kamal Bijlani (2013), "Trimmed Median Filters for Salt and Pepper Noise Removal," International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) Volume 2, Issue 1, January 2013.

[4] Esakkirajan.S, T. Veerakumar, Adabala N. Subramanyam, and C. H. PremChand (2011), "Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median Filter", IEEE Signal Process. Lett., vol. 18, no. 5, pp. 287–290.

[5] H. Hwang and R. A. Hadded (1995), "Adaptive median filter: New algorithms and results," IEEE Trans. Image Process., vol. 4, no. 4, pp. 499–502.

[6] Jiang Bo, Huang Wei (2010)," Adaptive threshold median filter for multiple-impulse noise," Journal of Electronic science & technology, mar.2007, vol.5 NO.1.

[7] Punyaban Patel, Banshidhar Majhi(2012)," Dynamic Adaptive Median Filter (DAMF) for Removal of High Density Impulse Noise", I.J. Image, Graphics and Signal Processing, 11, 53-62.

[8] Wang. Z and D. Zhang (1999), "Progressive switching median filter for the removal of impulse noise from highly corrupted images," IEEE Trans. Circuits Syst. II, vol. 46, no. 1, pp. 78–80.

[9] Zhang .S. and M.A.Karim (2010),"A new impulse detector for switching median filters," IEEE Signal Process. Lett, vol. 9, no. 11, pp. 360–363.

 DOI 10.17148/IJIREEICE.2016.4614