Research Article Impact Factor: 0.621 ISSN: 2319-507X
Piyush Dhande, IJPRET, 2014; Volume 2 (9): 145-151 IJPRET

INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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COMPARATIVE STUDY ON REMOVAL OF HIGH DENSITY SALT AND PEPPER NOISE THROUGH MODIFIED DECISION BASED UNSYMMETRIC TRIMMED MEDIAN FILTER

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Accepted Date: 27/02/2014 ; Published Date: 01/05/2014

Abstract: Noise is an unwanted parameter i.e. dot, line present in an image. There is several type of noise. Impulse noise in images is present due to bit errors in transmission or introduced during the signal acquisition stage. There are two types of impulse noise i.e. salt and pepper noise. Salt and pepper noise can corrupt pixel by taking either maximum or minimum gray level. Ideally, the filtering should be applied only to corrupted pixels while leaving uncorrupted pixels intact. The main function of filtering is to remove the impulses so that the noise free image is fully recovered with minimum signal distortion. Images cause infection by positive and negative impulses stemming from decoding errors or noisy channels. Both are easily identified by the eye which causes the poor image quality. To remove the noise from image median filter are used. The nonlinear mean filter cannot mitigate such positive and negative impulses simultaneously only when occurrence of noise is high& hence median filter are used. Here we will compare the different types of median filter for best quality of image.

Keywords: Median filter, salt and pepper noise, unsymmetrical trimmed median filter, Restoration, Peak Signal to Noise Ratio.

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How to Cite This Article:

Piyush Dhande, IJPRET, 2014; Volume 2 (9): 145-151

PAPER-QR CODE

INTRODUCTION

Due to the faulty communications, images are corrupted by salt and pepper noise, in the transmission of images over channels. Salt and Pepper noise is also known as impulse noise. Salt and pepper noise can corrupt the images where the corrupted pixel takes either maximum or minimum gray level. The noise which sprinkles on the images like white and black dots significantly reduces the visual effects of images [1]. By using filtering technique can remove the impulse noise so that noise free image is fully recovered with minimum signal distortion. Some nonlinear filters have been proposed for removal of salt and pepper noise which is presented in the image. Noise removal is common pre-processing step in which the recovered signal, in this case the image, would have better visual properties or have more meaningful data, thus, it can be used as a proper input for other algorithms such as edge detectors.

Some pepper and salt noise filtering algorithm includes: Adaptive Median (AM) filter algorithm [2][3], Traditional Median (TM) filter algorithm; Extreme Median (EM) filter algorithm etc. This entire standard median filter has been established as reliable method to remove the salt and pepper noise without damaging the edge details. But the major drawback of standard Median Filter (MF) is that the filter is effective only at low noise densities [4]. When the noise level is over 50% the edge details of the original image will not be preserved by standard median filter. Adaptive Median Filter (AMF) [5] performs well at low noise densities. But at high noise densities the window size has to be increased which may lead to blurring the image. In switching median filter (SMF) [6,7] the decision is based on a pre-defined threshold value. The major drawback of this method is that defining a robust decision is difficult. To overcome the above drawback, Decision Based Algorithm (DBA) is proposed [8].But this Algorithm produces sticking effect during replacement of pixel. To avoid drawback of this Algorithm Decision Based Unsymmetrical Trimmed Median Filter (DBUTMF) is proposed [9].But this algorithm does not give better results at very high noise density that is at 80% to 90%. The Modified Decision Based Unsymmetrical Trimmed Median Filter (MDBUTMF) algorithm removes this drawback at high noise density and gives better Peak Signal-to-Noise Ratio (PSNR) values than the existing algorithm.

II. LITERATURE REVIEW

In some of the researches it is seen that the main drawback of the median filter is that it also modifies non noisy pixels thus removing some fine details of the image. Therefore it is only suitable for very low level noise density. At high noise density it shows the blurring for the larger template sizes and not able to suppress the noise completely for smaller template sizes.

Therefore, contemporary switching filters split the denoising process in two steps. First one is detection of noise and second one is the replacement of the noisy pixel value with estimated median value.

Chen Cong-ping, et.al proposed adaptive weight algorithm method consists of two major blocks, detection and filtering. The detection block uses neighborhood pixels correlations to divide the pixels into signal pixels and noise pixels. Signal pixels are kept the same and only noise pixels are processed. For filtering block, the different approaches were taken according to the noise density situations. In the low noise density case, neighborhood signal pixels mean method is adopted. In the high noise density case, adaptive weight algorithm is used.

H.Hwang et.al [10] proposed two new algorithms for adaptive median filters. These have variable window size for removal of impulses while preserving sharpness. The first one, called the ranked-order based adaptive median filter (RAMF), is based on a test for the presence of impulses in the center pixel itself followed by the test for the presence of residual impulses in the median filter output. The second one, called the impulse size based adaptive median filter (SAMF), is based on the detection of the size of the impulse noise. It is shown that the RAMF is superior to the nonlinear mean *L,*

filter in removing positive and negative impulses while simultaneously preserving sharpness; the SAMF is superior to Lin's adaptive scheme because it is simpler and better performing in removing the high density of impulsive noise as well as non impulsive noise and in preserving fine details. Simulations on standard images confirm that these algorithms are superior to standard median filters.

Youlian Zhu, et. al [11] use linear or nonlinear filter methods to reduce noises. In the frequency domain, the details are high-frequency components of the image, which easily confused with high-frequency noises. Therefore, how to keep the image details and effectively filter random noises is the key to image filtering processing. The median filter is a nonlinear filter and it has widely used in digital image processing because of its good edge keeping characteristics and reducing impulse noise ability. The median filter is a rank-order filter. Its noise-reducing effects depend on the size and shape of the filtering mask; and its algorithm complexity mainly depends on how to get the median value. In order to improve the noise-reducing performance of the median filter, scholars proposed many improved methods to the conventional median filter . To improve the searching speed of the median value, people proposed some fast algorithms based on the dividing-conquering strategy, and simplified the algorithm complexity of the conventional median filter from O (N2) to O (n In n) . The prophase work of the paper further simplified complexity to O (n(1+ln n) /2). Based on the prophase study, this paper proposed two improvements to the median filtering algorithm:

Chih-Yuan Lien et.all [12], proposed an efficient denoising scheme and its VLSI architecture for the removal of random-valued impulse noise. To achieve the goal of low cost, a low-complexity VLSI architecture is proposed. We employ a decision-tree-based impulse noise detector to detect the noisy pixels, and an edge-preserving filter to reconstruct the intensity values of noisy pixels. Furthermore, an adaptive technology is used to enhance the effects of removal of impulse noise. this extensive experimental results demonstrate that the proposed technique can obtain better performances in terms of both quantitative evaluation and visual quality than the previous lower complexity methods. Moreover, the performance can be comparable to the higher complexity methods. The VLSI architecture of design yields a processing rate of about 200 MHz by using TSMC 0.18_m technology. Compared with the state-of-the art techniques, this work can reduce memory storage by more than 99 percent. The design requires only low computational complexity and two line memory buffers. Its hardware cost is low and suitable to be applied to many real-time applications.

M. Nasri et.al proposed [13], A Switching Non-Local Means (SNLM) filter is presented for high-density salt and pepper noise reduction. Firstly, the impulse noises are detected, based on the fact that their values must be the extreme gray-level of the image. Then, at the filtering stage, the noise-free pixels remain unchanged and noisy pixels are restored using a modified non-local means filter. However, to calculate the weights of the filter, only noise-free pixels are considered. It means that in a search window around the noisy pixel, some small patches are taken into account around noise-free pixels and the similarity between these patches and the central patch determines the weights. Experimental results show that the proposed method can provide better performance than many of the existing impulse denoising methods in high-density impulse noise in terms of PSNR, and MAE.

Gaihua Wang et al.[14] a modified switching median filter is presented for noise reduction in color images that are corrupted with impulse (salt and pepper) noise. It is a two-phase noise detector: in the first phase, he used the adaptive vector median filter detection method to identify pixels that are likely to have been corrupted by noise (as noise candidates); in the second phase, these noise candidates are judged by using four one- dimensional Laplacian operators, which allow edge pixels to be preserved. Extensive experiments show that the proposed method outperforms many existing vector filters in terms of filtering performance. In particular, the proposed approach can effectively preserve thin lines, fine details, and image edges.

Zhou Wang et al.proposed[15]progressive switching median (PSM) filter to to restore images corrupted by salt–pepper impulse noise. The algorithm is developed by the following two main points:1)switching scheme—an impulse detection algorithm is used before filtering, thus only a proportion of all the pixels will be filtered and 2)progressive methods—both the impulse detection and the noise filtering procedures are progressively applied through several iterations.

III. CONCLUSION

In this paper, we have observed the different types of filter which is going to remove the pepper and salt noise and it is observed that the main drawback of the median filter is that it also modifies non noisy pixels thus removing some fine details of the image. Therefore it is only suitable for very low level noise density. Therefore, contemporary switching filters split the denoising process in two steps. First one is detection of noise and second one is the replacement of the noisy pixel value with estimated median value. These are weighted median filter [16-17], adaptive impulse detection using center weighted median [18], rank order filtering algorithm [19].. The main disadvantage of the switching median filter [20] and decision based filter is that it is based on the predefined threshold. In order to overcome the disadvantages of these mentioned filtering techniques a two stage algorithm has been proposed. In this algorithm an adaptive median filter is used in first stage to classify the values of the noisy and noise free pixels and detail preserving regularization technique is used in second stage to preserve the details and edges as much as possible. Due to large template size, processing time is too large and more complexity is involved in its implementation. In order to avoid this drawback, open-close sequence filter (OCSF) has been proposed. This algorithm is based on mathematical morphology, which is suitable only for high density impulse noise (noise density ranging from 50% to 80%). The main drawback of this algorithm is that its performance is not good in very low noise density as well as in very high noise density. To overcome this drawback, decision based algorithm (DBA) is proposed. In this algorithm, image is denoised by using a 3X3 window. The image is denoised for pixel value '0' or '255' else it is left unchanged. At high noise density the median value will be '0' or '255' which is noisy. In such case, neighboring pixel is used for replacement. This repeated replacement of neighboring pixel produces streaking effect . In order to avoid this drawback, decision based unsymmetrical trimmed median filter (DBUTMF) is proposed .

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