MR Brain Image Enhancement and Removal of Impulse Noise Using Median Filters

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Abstract : The Magnetic Resonance Image (MRI) brain image is used to diagnose brain deceases in medical field. The medical image preprocessing is one of the recent techniques to identify the defected parts in human body. In this paper, we studied the approach of image enhancement using human brain MR image. The major objective of this work is to remove the unwanted noise from a given input image. We suggest the brain MR image de-noising methods are delivered. The linear filters are applied on the MR brain image and the results are noted. The experimental results of the studied method are compared with the other methods. The efficiency of the method was measured by the statistical parameters such as Mean Square Error (MSE) and Peak signal to Noise Ratio (PSNR).

***Index Terms* - MRI, Brain, Liner filters, MSE, PSNR, Impulse noise**

I. INTRODUCTION

The major problem of image processing is image de-noising. Generally, the digital images are related to digital signals, those signals are mostly corrupted through various kinds of noise with including impulse noise. Impulse noise is a collection of random pixels. Compared with other pixel it has high contrast [1, 2]. When the ratio of the impulse noise is minimum it alters the image is affected with other noises. Normally, impulse noise is caused by broken pixels in camera sensors, in hardware memory location fault, during the transmission of the noisy channel.

The overall objective of the image de-noising method it should be protect the image edges while elimination of noise as far as feasible. In general, there are various kinds of de-noising methods are used various researchers [3, 9]. Hence, median filters are providing better results. Functionality of the median filter depends on window size WM x MW both values are odd. Those values are replacing the value of center pixel that values are equal to the median of all the pixels with in the window. Advantages of the median filter will supports to reduce least and maximum intensity value of the pixels; comparison of the original image and filtered image, the clarity of the filtered was improved.

Most of the MR images affected with Rician noise such kind of noise is a signal dependent and subsequently splitting noise from signal is a crucial problem [4]. Image de-noising methods are used to maintain as far as the significant signal structures as feasible while eliminating the noise. Most of the filters are used to enhancing an image and found the edges of the images also. Normally, the filters are used to remove noise done by retransforming the image into high precise version of image pixels. Some noisy pixels are filtered out by taking by adjacent pixels into deliberation. Inappropriately, that noisy pixels can also considered as original finer parts, which can be misplaced in process. Particularly, there are no filtering methods to remove noise from affected image, so the noise removal algorithms are depends on the kinds of noise type or depends upon the noise scattering. Compared with mean filters median filters are good capability of de-noising and computational efficiency. But it has some difficulty of this technique was that it substituted the noisy pixels by certain median value with in area without taking into interpretation the occurrence of edges in the image. When the level of noise is high, particulars and edges were not recovered satisfactorily. In this work, we compare two filters such as Center Weight Median Filter (CWMF) and Adaptive Median Filter (AMF) are applied to eliminating noise and enhancing MR image. In this paper, found the best noise reduction model for medical image processing and diagnosis the deceases. The implementation result depicts the efficiency of the best median filter.

This paper is planned as follows: section II presents image acquisition, section III presents types of noise, section IV presents MR image pre-processing, section V presents results and discussion; section VI summary and conclusions.

II. IMAGE ACQUIREMENT

To sensing original real time medical image for carry out our study it's a very complicated one. So, the Brain MRI dataset is collected from universally accepted dataset such as McConnell Brain Imaging center of the Montreal Neurological Institute (MNI), MCGill University (http://www.bic.mni.mcgill.ca/brainweb). In this study, we have taking a brain image sample of 80 T1 weighted images for the purpose of image enhancement. Generally, such kind of dataset images have maximum of dark and brighter. The stored images showed as an array of pixels. Normally, the images are categorized in three types such as Binary image, Gray scale image and color image. In this paper, we have use the gray scale image that image size is 256 x 256.

III. TYPES OF NOISES

Generally, image noises are created by sensors and electrical fluctuation of the scanner or any other capturing device and over brightness or color information. Such kinds of noises created during to scraps in the film or during to the unavoidable noise existing in an ultimate devices [8]. The unwanted result of image grabbed is fundamentally that image noise. Very significant aspect which affects the noise simulations in any image are the equipment utilized for sensing the image generally, the utilized media for data transmission, the image quantization techniques and the distinct basis of radiation. Hence, natural images are pretentious by Gaussian noise, Where Rician noise are pretentious on MRI image[5,6].

IV. MR IMAGE PRE-PROCESSING

4.1Elimination of film Artifacts from MRI

The processes of MR image pre-processing we have use various kinds of enhancement techniques for removal of film artifacts or patients general details. The film artifacts removed by the help of tracking algorithm [7]. The algorithm starts from initial row and initial column of the pixels. Further, the pixel intensity value are analyzed and found the threshold value of the film artifacts. The value of film artifacts are eliminated from the MRI. When, the artifact threshold is greater than the value of fixed threshold.

4.2Center Weighted Median Filter (CWMF)

In general the medial image processing, is an essential for minimizing noise in MR image before execution of further process. Normally, the median filters eradicate noise, maximum frequency devices from MR image without disturbing the image edges and it is used to minimize the salt and pepper noise. The process of median filter is, to determine the median of the adjacent pixels to regulate the new value of the pixel. Initially, all the pixels are sorted according to their size. Further, chose the median value as the new value for the pixel. The sum of the overall pixel is used to determine the median.

Weighted median are used to remove the impulse noise from MR images with contrast. Working principle of the median filter used in rank order filtering. The intensity value of the MR image pixel value is used to decide the weight of the filter. Weighted median filter use four weights such as (0, 0.1, 0.2and 0.3).

Algorithm

Step 1: If (Intensity value=0)
Then (pixel weight=0)
Step 2: Else (intensity value = 1 to 100)
Then (pixel weight=0.1)
Step 3: Else if (Intensity value=101 to 200)
Then (pixel weight =0.2)
Step 4: Otherwise
(Pixel weight =0.3)
Then (pixel weight x pixel intensity value)

The functionality of the CWM filter is gives high weight to each central value of the each window. The advantages of this filter are preserving the image information when overwhelming additive white and /or impulsive noise. Normally, the properties of the CWMF are examined. Compare to other median filter CWM filter is outstanding image information smoother that can overwhelm signal depended noise as well as signal-independent noise.

Algorithm of large weight CWM filter

Step1: w (0, 0) =2K+1
When K>=0 (All other non-zero weights are equal to 1)
Step2: w (i, j) =1
For (i, j) is not equal to 0.
K is a non-negative integer.

Generally the CWM filter is entirely stated by two parameters, such as size and center weight[4]. These two parameters are controlled by CWM filters. The center weight of the median filter is 2K+1 by CWM (M; 2K+1), Here M is the number of the examples in the window like M= (2N+1) x (2N+1) for associated square window. Figure 1 shows the original and enhanced image.

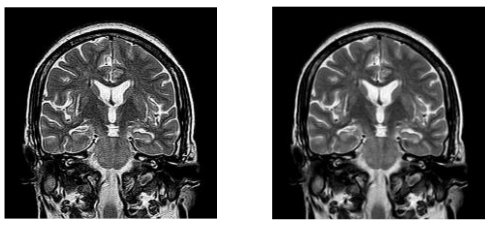

Figure 1. a) Original MR image
b) Enhanced MR image using CWMF

4.3Adaptive Median Filter (AMF)

The adaptive median filter is used to eliminate the impulse-noise. The process of the AMF, the window size is surrounded by the pixel variables. This difference depends on the median of the pixels in the current window. Suppose the median value is an impulse, then the window size is extended.

The process of AMF is to evaluate the center pixel of the window to verify it's an impulse noise or not. Suppose it is an impulse, which the new value of that pixel in the filtered image it is a median value of the pixels in the window. If, the center pixel is not an impulse, further the value of the center pixel is reserved in the filtered image. Therefore, without the pixel actually measured an impulse, the pixel value of the filtered gray-scale image is same as the input image. Therefore, the AMF solves the two purposes of eliminating the impulse noise from the image and decreasing distortion in the image. AMF can hold the filtering process of an image degraded with impulse noise of possibility greater than 0.2.

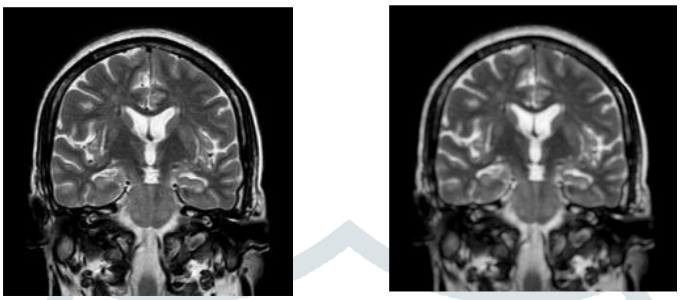

Figure 1. a) Original MR image
b) Enhanced MR image using AMF

V. Results and Discussion

This both filters are tested in various MR images take from database. In this work has been implemented by using MATLAB. The MR image enhancement using CWMF and AMF it is very complicated measure the improvement of the enhancement. Suppose the enhanced image PSNR value is better, and then we can observe that the original image was developed. The above mentioned two filters are used to enhancement process further, those images are compared and the differences are noted. The statistical measurement such as PSNR and MSE can always found the contrast enhancement, the performance evaluation of the studied work of the CWMF and AMF are analysed and estimated. Table. 1 depicts the performance comparison of the studied work. The better performances of the studied filters are evaluated by the help of the figure 2. Finally, we found the better filter. After the performance evaluation the CWMF is better than compared with AMF. This filter is used for eliminating noise from MR images with higher level of contrast.

Table 1. Performance Comparison of CWMF/AMF

Image	CWMF		AMF	
	PSNR	MSE	PSNR	MSE
1	63.21	6.281	20.71	15.432
2	61.29	6.182	22.34	15.732
3	64.65	6.193	19.83	14.304
4	52.56	5.371	32.36	15.140
5	50.98	6.733	30.43	14.521

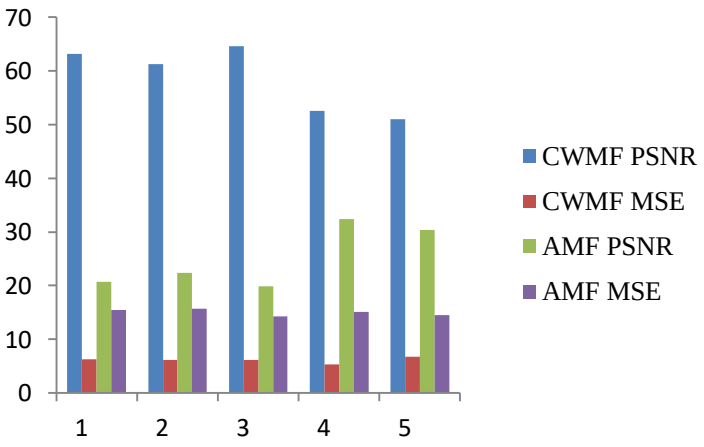

Figure 2. Performance Comparison of CWMF/AMF

VI. CONCLUSION

Our studied work is combination pre-processing and image enhancement of the MR brain image. The input MR image is given to pre-processing. Initially, the film artifacts are removed by the help of tracking algorithm and noises are removed achieved by filters such as CWM and AM filters. The better performance of the filters are measured and evaluated by the support of PSNR and MSE. Finally, we identify the best filter is CWM filter. This filter is used for eliminating noise from MR brain images with higher level of contrast.

VII. ACKNOWLEDGEMENT

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