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Review paper on Noise Removal Algorithms for MRI Image using Various Filters

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ABSTRACT: Medical images convey important information to the doctor about a patient's health condition. Internet transmits these medical images to remote locations of the globe to be examined by expert doctors. But data transmission through Internet invokes noise problems for any image data. Medical images contain health information about a patient. The inability of the medical images to show information clearly and lack of experts in these areas, motivates the patients to send their imaging reports to major doctor experts via unsecured internet. To provide security to unsecured medical images of patients various methods are used. In this paper, various filtering algorithms are discussed and compared and we found that the modified median is better salt and pepper high density removal in MRI image. We discussed in proposed modified median technique is used to final paper.

KEYWORDS: MRI brain image, wiener, mean, median, image processing.

I. INTRODUCTION

Making high quality health care accessible to majority human beings around the globe is a major concern to the administrators, governments and politicians. Traditionally, medicine was practiced until recently on a local basis where the medical practitioner and patient are physically present at the same place. But recent advances in information and communication technologies (ICT) have augmented the number of ways in which healthcare can be distributed to remote parts of the world. The intermittent developments of Internet and Multimedia Technologies had made possible the duplication of digitally produced information effortless and straightforward. The progression in embedded chip technologies has made it possible to generate, duplicate, broadcast, and dispense digital contents in an unforced manner. In the new morden world everyone want easy to easy life ,everything available in easy way so everyone do hard work for make difficult thing become too easy for comfortable future life and enjoy morden device, instrument, technique I also participate in world of completion and try to understand working of magnetic resonance imaging and try to do all the difficult thing make to understand in simple way simple definition and follow a proper way and I would like to understand root cause of problem then how to solve it ,I explain everything by diagrammatic visualization for easy to understand content of any topic and we can easily remember picture view ,in today life many devices comes in to the market for make thing easy and save the time ,high quality and with good accuracy in the digital india everything we doing on computer, mri device is also one part of digital world which give good and high quality image of human body of internal organ structure ,situation on computer display it make very easy to understand human disease like any tumor and disorder of bones means any internal injury during the accident but in world nothing is 100% accurate and cannot give 100% information without noise , noise is unwanted thing which create problem in easy life to understand any simple thing ,my work in this thesis is try to reduce noise by using some mathematical formula ,filter, new concept new tools I try to give my best effort for reduce noise to some extent ,many devices, technology came in to the market since many years like ct scan, x-ray ,pet, ultra sound all the devices gives the image first on computer display after that we get hardcopy by printing device so my all work on computer by using some mathematical formula and some tools and try to remove noise ,we all are very familiar with computer so it very easy to understand the concept of noise remove.

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II. LITERATURE REVIEW

Neela Chithirala et al. [1], noise removal from a contaminated image signal is a prominent field of research and many researchers have suggested a large number of algorithms and compared their results. The main thrust on all such algorithms is to remove impulsive noise while preserving image details. These schemes differ in their basic methodologies to suppress noise. Some schemes utilize detection of impulsive noise followed by filtering whereas others filter all the pixels irrespective of corruption. In this section, attempts have been made for detailed literature reviews of impulse noise removal on the reported articles and a study of their performance through computer simulation. The various schemes for image denoising are broadly classified based on the characteristics of the filtering schemes.

Bhat Jasra et al. [2], in traditional median filtering called Standard Median filter (SMF), the filtering operation is performed across each pixel without considering whether it is corrupted or not. So, the image details contributed by the uncorrupted pixels are also subjected to filtering and as a result, the image details are lost in the restored version. To alleviate this problem, an impulse noise detection mechanism is applied prior to the image filtering. In switching median filters, a noise detection mechanism has been incorporated so that only those pixels identified as “corrupted” would undergo the filtering process while those identified as “uncorrupted” would remain intact.

Priyanka Punhani et al. [3], Magnetic Resonance Imaging is most popularly used techniques in clinical diagnosis. During acquisition, image quality is degraded by certain noise and artifacts. Due to which, it is difficult to interpret important details of user. So it becomes necessary to denoise image. There are various denoising methods available now days. Noise removal techniques have become an essential exercise in medical imaging applications, for the study of anatomical structures. The most commonly affected noises in medical image are salt and pepper, Gaussian, Speckle and Brownian noise. In this paper, the medical images taken for comparison include MRI brain images, in gray scale and RGB.

Tian Bai et al. [4], a Minimum-Maximum Exclusive Mean (MMEM) filter to remove impulse noise from highly corrupted images is proposed. This is a simple nonlinear, robust filter that centers around two windows of size 3×3 and 5×5. It checks for a particular range of gray level in the 3×3 windows. If it fails, it goes to 5 ×5 window. If the average of all the pixels of that particular range is more than a certain value then that pixel is replaced with the average, otherwise it is left intact. This is one of the good schemes filters like SMF, rank-ordered mean (ROM) because of its simplicity and easy implementation.

Chauhan et al. [5], Noise is an ingrained phenomenon in the medical images which may increase the root mean square error and reduce the peak signal to noise ratio. NLM filter is used for the removal of speckle noise and shrinkage rule is used to shrink the content of noise present in the brain images by means of the thresholding technique. Image Denoising and Image Segmentation are the two major areas of the medical image processing. The main objective of this paper is to develop a robust segmentation algorithm inorder to detect tumor in 2D MRI brain images. Here we use image denoising as the pre-processing step as noise plays an important role in case of accuracy of affected area of the image, especially in medical diagnostics.

III. DIFFERENT NOISE MODELS

Noise is a disturbance which turns into the reason of fluctuations in the pixel values. Hence this pixel values represent random variations & this cannot be tolerated. Due to different sources, noise occurs. These sources include many external reasons in transmission system and environmental elements which includes noise like Blurred, Gaussian, Poisson, Speckle and salt-and-pepper noise. Noise removing method has turned into an essential factor in medical imaging applications and the most commonly used filters are Median filter, Gaussian filter, Weiner filter which gives the best outcome for the respective noises.

The requirement for the smoothening of images has becomes essential that is required to eliminate the noise and for that best filters or standard filters are used in almost of the image processing applications. To remove the noise from the image is essential tooling of a good image de-noising model and also conserve the edges. There are two knds of models

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which are utilized for de-noising i.e. linear model and non-liner model. Because of speed and limitation, linear models are used by which it is not able to maintain the edges in an efficient way. This information is observed by using filters and try to find out the best filter. Best filter can be found out on the basis of the histogram, size and clarity of the MRI images provided to these filters.

Different Type of Noise in Medical Images

The procedure which attempt to expel the noise from the image and restore the quality of the original image is known as Image Restoration. It is an essential feature in maintaining the quality of the image by using restoring the pixel value. For linear image degradation, Restoration techniques are a model and it is the just opposite process of improving the quality of original image. To find an optimal gauge of the desired outcome restoration technique includes mathematically principle of goodness which accomplishes it.

Speckle Noise:

Speckle Noise is a multiplicative noise. It is a random signal where the average amplitude increases with the overall signal intensity. It appears as bright specks in the lighter regions of the image.
It can be modelled as a pixel value multiplied by the random value.
Speckle Noise can be modelled as

$$I = S + (S*Ng)$$

Where Ng is the random noise having a zero mean Gaussian probability distributive function.
The Speckle Noise is available in the images and which debases the quality of an image. So the speckle noise is characterized by this way. Speckle Noise is a that phenomenon which convoys all coherent imaging modal quality in which images are created by restricting echoes of a transmitted waveform. Transmitted waveform can be derived from diversity of the studied objects .Granular noises are basically present in the image and the quality of the active radar and Synthetic Aperture Radar (SAR) images or Magnetic Resonance. So Speckle noise is basically granular noise. Imaging (MRI) images refers by Speckle Noise. If Speckle Noise is available in the conventional radar results from random variations in the return signal from an object which is no longer image process signal increases the mean grey level in an image. The coherent imaging of objects in the image is a Speckle Noise. In actual fact, it occurs due to errors in data transmission. The ultrasound images and MRI images are affected by this type of noise.

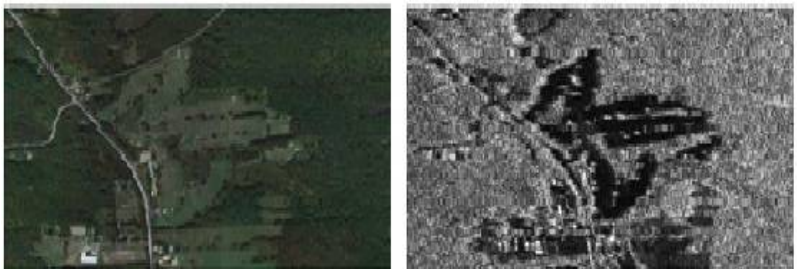

Figure 1: Speckle Noise

This type of noise occurs in various imaging systems such as Laser, Medical, Optical and SAR imagery. The source of this noise is a form of multiplicative noise in which the intensity values of the pixels in the image are multiplied by random values. Speckle noise in image is serious issue, causing difficulties for image representation. It is caused by coherent processing of backscattered signals from multiple distributed targets. The fully developed speckle noise has the characteristic of multiplicative noise. Speckle noise in image is a multiplicative noise.

Gaussian Noise:

Gaussian noise is also known as additive noise & can be modelled as a simple additive. It is evenly distributed over the signal. This means that each pixel in the noisy image is the sum of true pixel value & a random Gaussian noise value.
Mathematically denoted as

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$$F = S + Na \text{ or } S - Na,$$

Where Na is the Gaussian probability density function (PDF) & S is the noiseless image.

It affects both the dark & light areas of the image. Gaussian noise removal algorithms should smooth the distinct parts of the image. In image processing Gaussian noise can be reduced using spatial filter. A special case of Gaussian noise is white Gaussian noise, in which the values are statistically independent which describes the correlation of noise. Gaussian noise is used as a additive white noise to produce additive white Gaussian noise. Figure 2 a shows the image after Gaussian noise.

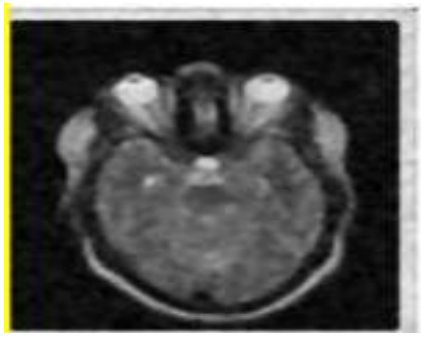

Figure 2: image after Gaussian noise

Salt and pepper Noise:

It is also known by various names such as shot noise, Impulse noise and binary noise. Salt and pepper noise is a form of noise sometimes seen on images. Noise can be caused by sharp and sudden disturbance in image signal. This noise is mostly caused by sensor & memory problems due to which pixels are assigned incorrect maximum values. The corrupted pixels are set alternatively to the minimum or maximum value & unaffected pixels remain same, giving the image salt & pepper noise like appearance. It presents itself as sparsely occurring white and black pixels. An effective noise reduction algorithm for this type of noise involves the usage of a median filter. Minimum filtering ,maximum filtering ,mean filtering, rank order filtering are the some other filters which reduced less amount of noise compare to median filter without significantly reducing the sharpness of the image, salt and pepper noise can be reduced.

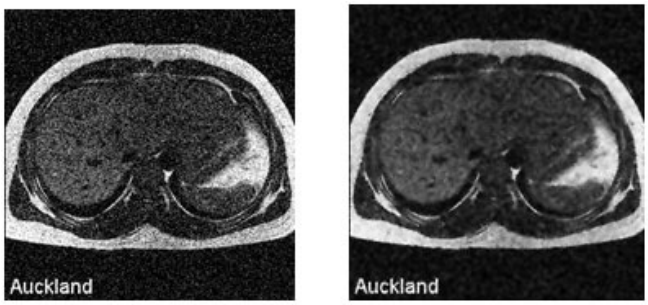

Figure 3: Salt and Pepper noise

Noise Removal Techniques:

Image de-noising is an important image processing which includes both process itself and as a component in other process. There are many ways to de-noise an image. It is solved by using different algorithms. Accordingly, noises are spotted with neighboring information and are removed using best filtering techniques without affecting the image quality and reinforce the smoothness of the image taken for examination.

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Gaussian filter:
Speckle Noise is typical noises which is caused due to internal or external factor and are generally present in the digital images and MRI images. Gaussian filter is implemented to remove the Speckle Noise present in ultra sound images or MRI brain images. In this technique, the average value of the surrounding pixel or neighboring pixels replaces the noisy pixel present in the image which is based on Gaussian distribution.

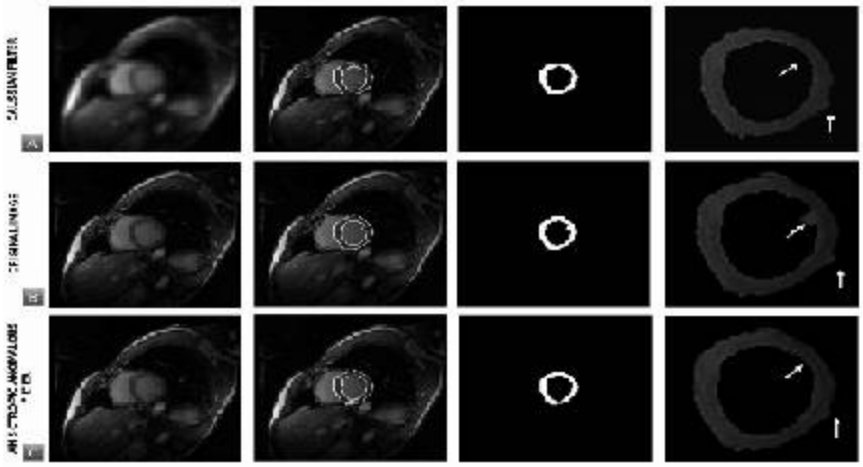

Figure 4: Image after Gaussian Filter

Maximum Filter:
This filter selects the largest value in the sorted list. The largest value is the last element of the list. This filter is used for removing pepper type noise
For the given example, the largest value of the sorted list is underlined.

{12, 13, 14, 15, 17, 18, 19, 20, 21}

However, the procedure is the same where the mask is moved till the entire image is processed.

Minimum Filter:
This filter selects the smallest value, which is the first element of the sorted list. It is very effective in eliminating salt-type noise.
For the given example, the minimum value of the sorted list is underlined.

{12, 13, 14, 15, 17, 18, 19, 20, 21}

Median Filter:
The Median filter is the popular known order-statistic filter in digital image processing. Median filter is very popular technique for the removal of impulse noise because of its good de-noising power and mathematical accuracy. The value of a pixel is replaced by a median of the intensity levels in the neighborhood of that pixel by the Median Filter. A fixed filtering window size is used for outcome of neighborhood pixels by the Median Filter. The median filters are implemented consistently across the image and therefore tends to modify both noisy and noise free pixels present in the image. Relation to this, there is always a chance of replacement of good pixels by some corrupted ones. Therefore, de-noising is often accomplished at the expense of blurred and distorted features thus removing fine details present in the image.

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Figure 5: image after maximum, minimum & median filter

Noise modeling in images is affected by capturing instrument, data transmission media, image quantization and discrete source of radiation. Gaussian noise (random additive) is observed in natural images [8], speckle noise is observed in ultrasound images [9-11] where as rician noise [2] affects magnetic resonance image (MRI). The characteristics of noise depend on its source, as does the operator which reduces its effects.

IV. CONCLUSION

Noise is one of obstacles in automatic image understanding and noise reducing is very important to improve the results of this process. In this paper various filtering algorithms are implemented on MRI images to remove different types of noise. MRI images when captured usually have Gaussian noise and salt and pepper noise. To remove this noise filtering algorithms are introduced. The results are analyzed and evaluated. Through this work we have observed that the choice of filter for enhancing the MRI image depends on the type of the filtering technique, which is used. Among various filters mean filter, anisotropic filters are less efficient. Median filter performs better result in MRI brain image to remove noise. The further work of this modified median filter technique and will be achieved 30-40% increase PSNR and 10-15% reduces MSE.

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