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Survey on Noise Removal in MRI Brain Image for Various Filters

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ABSTRACT: In an advanced imaging technique Magnetic Resonance Imaging (MRI) plays a major role in medical setting to create high standard images contained in the human brain. MRI imaging is often used when treating brain, prostate cancers, ankle and foot. The MRI images captured are usually liable to suffer from Gaussian noise, salt and pepper noise; speckle noise etc., Therefore obtaining of brain image with accuracy is very difficult task. An accurate brain image is very indispensable for further diagnosis process. Image processing algorithms are applied to the captured MRI data and detach the noise, thus preserve the integrity of fine medical image structure. 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

Magnetic Resonance Imaging (MRI) has become a widely used method of high quality medical imaging, especially brain imaging where MRI's soft tissue contrast and noninvasiveness is a clear advantage [1]. MRI provides a perfect view inside the human body. The level of details we can see is remarkable on being evaluated with other imaging modality. MRI is a medical imaging technique that measures the response of atomic nuclei of body tissues to high frequency radio waves when placed in a strong magnetic field and that produces images of the internal organs [2]. MRI differs from other modalities like X-ray, Computed Tomography in such manner that it can characterize and discriminate among tissues using their biochemical and physical properties. Also, without moving patient it can produce sectional image of equivalent resolution. This adds to its flexibility and diagnostic utility which gives it special advantage for surgical treatment planning [3]. MRI is primarily used to demonstrate pathological or other physiological variations of living tissues and is a commonly used form of medical imaging. Because of the resolution of MRI and the technology being essentially harmless it has emerged as the most accurate and desirable imaging technology. MRI imaging is often used when treating brain, prostrate cancers, ankle and foot. It can also be used for identifying diseases such as Parkinson's, Alzheimer's, brain tumors and stroke [4][5]. Despite significant improvements in recent years, magnetic resonance (MR) images often suffer from low Signal to Noise Ratio (SNR) especially in brain imaging.

II. LITERATURE REVIEW

B Deepa et al. [1], 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.

Babu G et al. [2], 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.

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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.

L.Ramya et al. [4], 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 preprocessing step as noise plays an important role incase of accuracy of affected area of the image, especially in medical diagnostics.

III. VARIOUS FILTER

KSL Filter:-

One of the filtering algorithms is KSL filtering algorithm. KSL is nothing but it is the combination of kernel, sober and low pass filter. Apply the kernel filter to the MRI brain image, where kernel matrix is applied to every pixel in the image. The values have been multiplied; the pixel is changed with SOP. By picking out various kernels, different types of filtering can be applied. This provides LPF and HPF using a kernel. Next pass through sober filter which performs 2-D spatial gradient measurement on an image. Filtered image is passing through LPF which is best suited for smoothing of an image. This tends to retain the low frequency information with in an image. The KSL filtering technique for MRI is implemented in MATLAB and tested with different synthetic and real clinical images this results in noise removal in different types of MRI images like low SNR MRI, partially parallel MRI and so on.

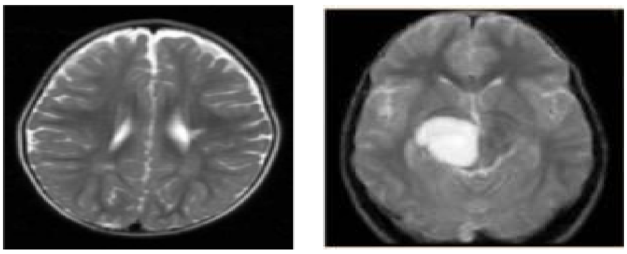

Figure 1: Original image, image after KSL filtering

Median Filter:-

Median filtering is a nonlinear method used to remove noise from MRI brain images. Widely used method to preserve edges. It is particularly effective at removing salt and pepper noise. Median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. The pixel is calculated by first sorting all the pixel values from the pattern of neighbours into numerical order, and then replacing the pixel being considered with median pixel value. Median filter is better able to remove noise without reducing the sharpness of the image.

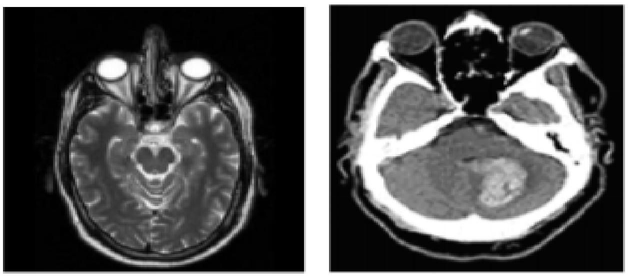

Figure 2: Original image, image after Median filtering

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Wiener Filter:-

Wiener filtering carries out an optimal between inverse filtering and noise smoothing. It removes additive noise and deburring concurrently. This proves to be optimal in reducing the overall Mean Square Error (MSE). The operation involves two parts. One is inverse filtering and the other is noise smoothing. Wiener filters belong to a kind of optimum linear filters with the noisy data as input which involves the calculation of difference between the desired output sequences from the actual output. The performance can be measured using Minimum Mean-Square Error.

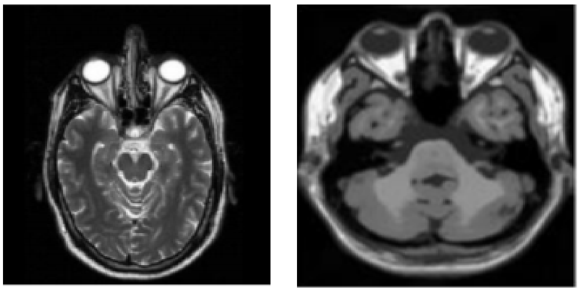

Figure 3: Original image, image after Wiener filtering

Adaptive Filter:-

Wiener2 is a 2-D adaptive noise removal filter. The wiwner2 function applies a wiener filter which is a type of linear filter to an image adaptively, tailoring itself to local image variance. Where the variance is large, wiener2 performs little smoothing. Where the variance is small, wiener2 performs more smoothing. This approach often produces better result than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high frequency parts of an image. In addition, there are no design tasks; the wiener2 function handles all preliminary computations, and implements the filter for preliminary computations, and implements the filter for an input image. Best suitable to remove Gaussian noise.

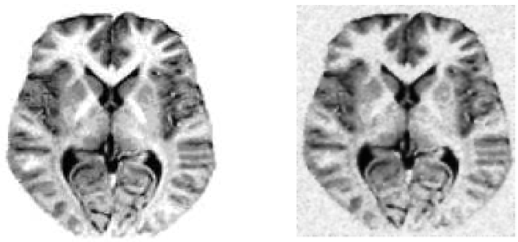

Figure 4: Original image, image after adaptive filtering

Mean Filter:-

Mean filter is the optimal filter for removing grain noise in an image. It is a linear filter that applies mask over each pixel in the signal. Each of the components of the pixels coming under mask are averaged together to form a single pixel that is why the filter is otherwise known as average filter and is given by

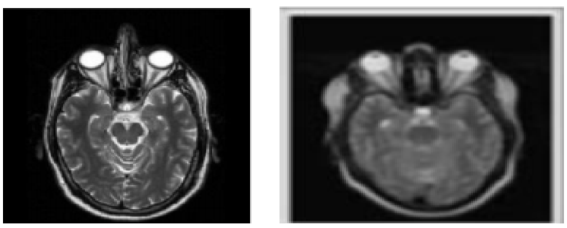

Figure 5: Original image, image after mean filtering

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Noise is the undesirable effects produced in the image. During image acquisition or transmission, several factors are responsible for introducing noise in the image. Depending on the type of disturbance, the noise can affect the image to different extent. Generally our focus is to remove certain kind of noise. So we identify certain kind of noise and apply different algorithms to remove the noise. Image noise can be classified as Impulse noise (Salt-and-pepper noise), Amplifier noise (Gaussian noise), Shot noise, Quantization noise (uniform noise), Film grain, on-isotropic noise, Multiplicative noise (Speckle noise) and Periodic noise.

Impulse Noise (Salt and Pepper Noise):- The term impulse noise is also used for this type of noise [5]. Other terms are spike noise, random noise or independent noise. Black and white dots appear in the image [6] as a result of this noise and hence salt and pepper noise. This noise arises in the image because of sharp and sudden changes of image signal. Dust particles in the image acquisition source or over heated faulty components can cause this type of noise. Image is corrupted to a small extent due to noise.

IV. COMPARATIVE STUDY

Among various types of filters, each has different characteristics and working of each one is different for different types of images. Various filtering technique are applied on the MRI brain image which help for the comparative study among different types of filters.

Table 1: Comparative Result

Filters	Effects
KSL filtering	Noise removal in different types of MRI brain images like low SNR MRI, partially parallel MRI and so on
Median filtering	Remove the outlier without reducing the sharpness of the image. So performs better result in MRI brain for noise removal.
Wiener filter	Involves noise smoothing and inverse filtering.
Adaptive filter	Requires less computation time
Mean filter	Removing grain noise from an image

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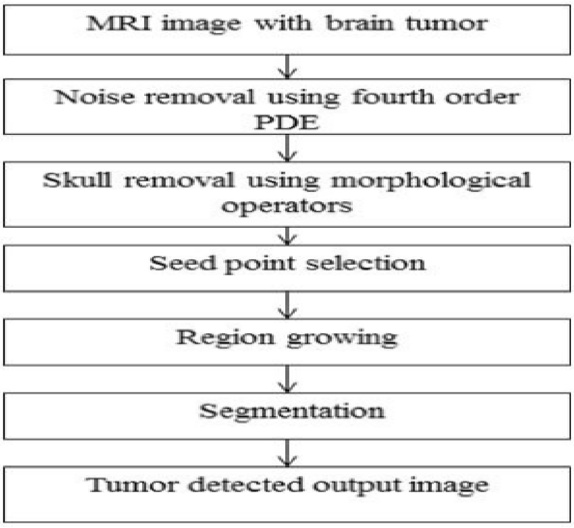
Proposed Methodology:



V. 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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