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Analysis of Image Denoising Methods on MRI images of Brain

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ABSTRACT

Noise removal techniques is an essential mechanism in medical applications to remove noise which is accompanied during transmission of images or equipment specification. So different algorithms have been proposed in spatial and frequency domain to remove noises and study the anatomical structures. In this paper, the medical images taken for comparison are grey scale MRI images of brain. Gaussian noise, salt and pepper noise, Poisson noise, speckle noise these are the common noises which are accompanied with the images. Median filter, mean filter, bilateral filter, Gaussian filter are the filters used to remove noise in the image. Performance metrics are used to evaluate the filters which is best suitable to remove the noises in the image

KEYWORDS: MRI Images**,** Gaussian noise, salt and pepper noise, Poisson noise, speckle noise

I. INTRODUCTION

Noise can be defined as the random variation and visible as the grains in the image, the variation in the pixels intensity level instead of true pixel values obtained in the image. The denoising methods are most important in reducing the noise component and preserving the quality of image features. The noise in MRI images may be due to field strength, RF pulses, RF coil, voxel volume, or receiver bandwidth. Different algorithms are used depending on the noise model. Salt and pepper noise, Gaussian noise, impulse noise, and Brownian noise these are the different noises which are accompanied. Mean filtering, Median filtering, Bilateral filtering, Gaussian filtering etc. These are some of the techniques used to remove noise in the images. The rest of the paper is organized as the following sections: section II describes related work, section III describes the methodology, experimental results in section IV and conclusions in section V

II. LITERATURE REVIEW

Digital image processing is a technique which is used and implemented in various fields of medical applications. Noises are the variation in the pixel intensity values and visible like grain like structures in the image. Various denoising algorithms are used to detect and remove noises

in the MRI images of brain. It is used to preserve the image quality and contrast of the image. Grey scale MRI images of brain are used in this research.

In this article [1] have proposed a novel approach that is combined features of three filters such as median filter, SWT and unsharp masking filter. Wavelet based denoising approach is also used to preserve the image quality and contrast. Then the performance metrics are used to evaluate the comparison of different filters used and gives the result. In paper [2] authors have used different filtering techniques to remove noises from the image. Few techniques in spatial domain are hybrid median filter, Weiner filter, bilateral filter, histogram equalization and in frequency domain are wavelet transform, independent component analysis were used in medical imaging. The comparative analysis is performed and the best suitable results are obtained. In paper [3] authors have used various types of noise filtering techniques in MATLAB environment. Noises reduce the true identity of the image and shows effects like blurred corners, unseen lines, unknown dots, and so on. They have used wiener filter, bilateral filter, mean filter, median filter and so on. They have analysed the performance of various filters for different noises. The PSNR shows the performance of the filter. In paper [4] authors have used the machine learning approaches and compressive framework algorithms to remove noises in medical imaging applications. They use machine learning algorithms to predict the values based on their properties .they evaluate different filtering algorithms based on CAD system.

In paper [5] authors have used the fuzzy segmentation, k-means algorithms to detect the noise in the image. In this paper they use VRMSE technique to perform validation and evaluation of the filters and result is obtained. They have used performance metrics such as MSE, PSNR, RMSE and so on. The advantage of VRMSE is low complexity and very simple implementation. Table 1 depicts the existing techniques used.

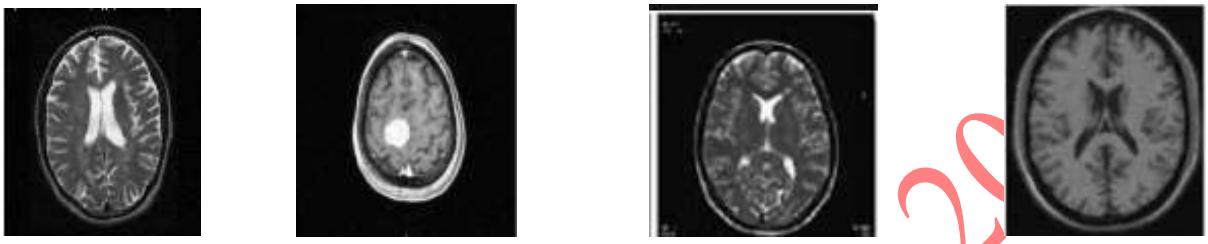
Table1: Existing methods used.

Papers	Techniques used
Novel Approach For Noise Removal of Brain Tumour MRI Images	Novel approach with features of median filter, SWT and Unsharp masking filter and wavelet transform.
Comparative Analysis of Noise Removal Techniques in MRI Brain Images	Hybrid-median filter, Weiner filter, bilateral filter, histogram equalization and in frequency domain are wavelet transform are used
Performance Analysis of Denoising Algorithms for Human Brain Image	Adaptive filter, order static filter, geometric mean filter, Weiner filter.
A Review of Denoising Medical Images Using Machine Learning Approaches	Machine learning algorithms, datamining methods, naïve bayes algorithms, ANN.
Validation of Denoising Algorithms for Medical Imaging,	Fuzzy-segmentation-means algorithms,VRMSE techniques.

III. PROPOSED METHODOLOGY

Image denoising techniques plays a major role in digital image processing .the main aim of denoising techniques is to remove noise from the image. Noises are the random variation or grain like structure found in the image. Gaussian noise, Salt and pepper noise, uniform noise, impulse noise, speckle noise, Brownian noise, racian noise etc. these are different types of noises present. To remove noises various filtering techniques such as mean filter, median filter, wiener filter, bilateral filter, gaussian filter, adaptive filter are used. So thereby the image quality is preserved and contrast of the images are improved.

These are the sample images which are used in this paper



Algorithm:

- Add noise to the original image taken from the dataset.
- Load the input image with added noise
- Apply the different noise filtering techniques such as Mean, Median, Gaussian, and Bilateral filtering techniques.
- Obtain the output from the required filtering techniques.
- The images are evaluated using performance metrics such as PSNR and MSE to enhance the image quality.

IV. IMPLEMENTATION

This research is implemented in MATLAB, OPENCV, AND PYTHON environment it works on Windows OS and it is user friendly .Dataset and Environment used:

For training and testing, we used Kaggle Alzheimer's brain dataset which comprises of nearly 680 grayscale MRI images of brain.

Environment:

Anaconda environment installed ideally with Python 3.7.3 and other libraries like Scikit, Ski image, NumPy, OpenCV and Matplotlib is installed. Minimum of 8GB RAM is required.

V. Experimental Results

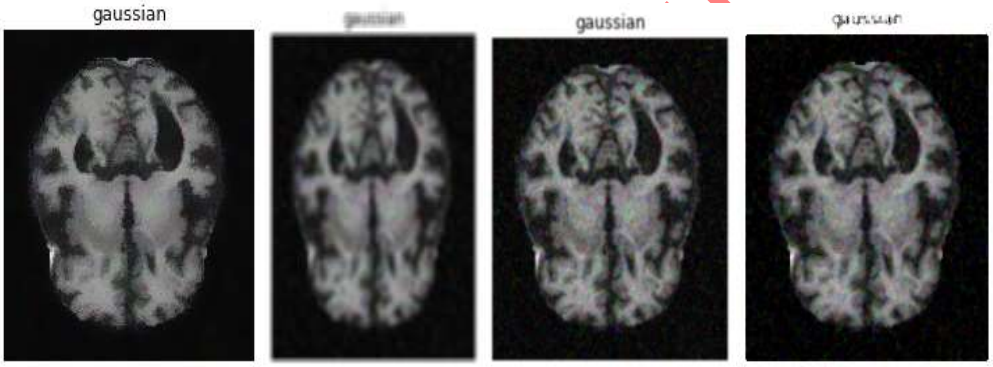
In medical imaging applications, the denoising techniques plays a major role in removing noises. In this paper we use grey scale MRI images of brain. Gaussian noise, Speckle noise, Salt and pepper noise, Poisson noise are the different types of noises used , Mean filter, Median filter, Gaussian filter , Bilateral Filter are the filtering techniques used to remove noises. The filtering techniques are evaluated using performance metrics such as PSNR (peak to signal noise ratio) and MSE (mean square error) methods. By computation of performance metrics

the best suitable filters are obtained. Median and bilateral filters are best suitable for removing noises in the image.

INPUT:

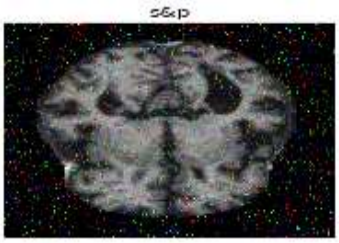
Gaussian noise image

OUTPUT:

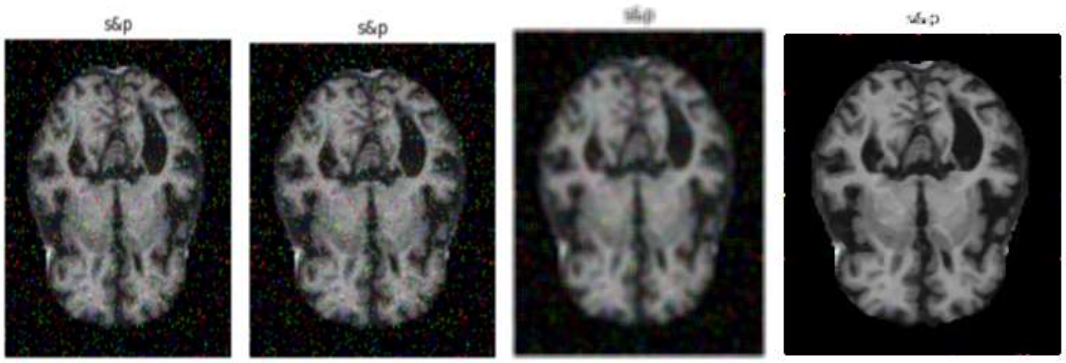


BILATERAL FILTER **GAUSSIAN FILTER** **MEAN FILTER** **MEDIAN FILTER**

INPUT:

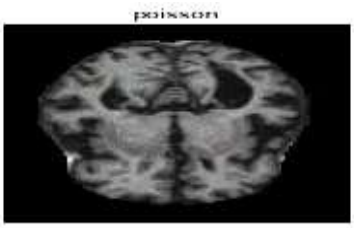


OUTPUT:

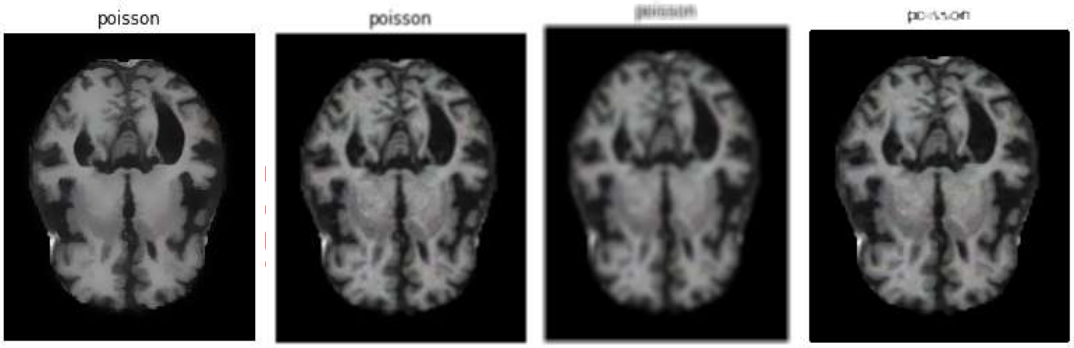


BILATERAL FILTER GAUSSIAN FILTER MEAN FILTER MEDIAN FILTER

INPUT:

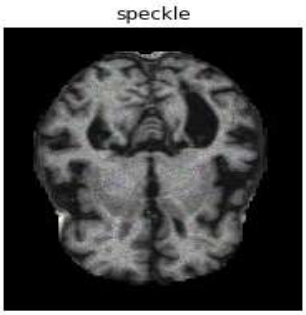


OUTPUT:

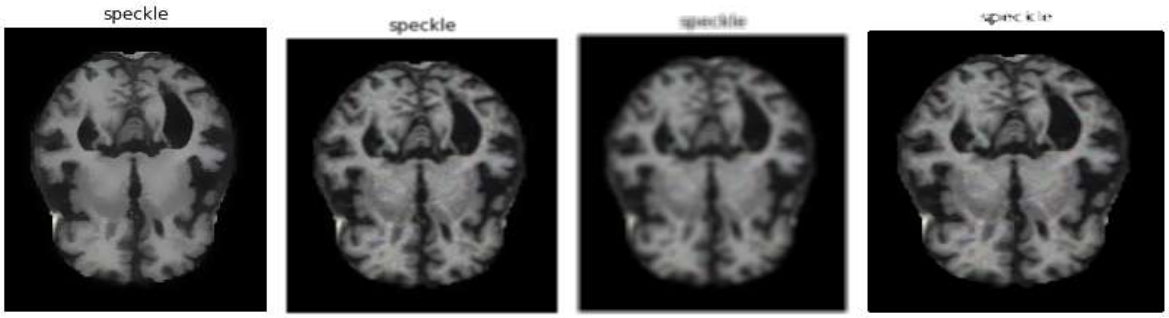


BILATERAL FILTER GAUSSIAN FILTER MEAN FILTER MEDIAN FILTER

INPUT:



OUTPUT:



BILATERAL FILTER **GAUSSIAN FILTER** **MEAN FILTER** **MEDIAN FILTER**

VI. PERFORMANCE METRICS:

NOISES	PERFORMANCE METRICS	GAUSSIAN FILTER	MEAN FILTER	MEDIAN FILTER	BILATERAL FILTER
GAUSSIAN NOISE	MSE PSNR	65.55 29.96	79.236 29.141	54.145 30.795	65.44 29.972
SALTAND PEPPER NOISE	MSE PSNR	21.335 34.8397	56.003 30.6486	10.279 38.011	22.638 34.5823
POISSON NOISE	MSE PSNR	23.322 34.4531	40.681 32.036	26.372 33.919	27.496 33.738
SPECKLE NOISE	MSE PSNR	22.716 34.5673	40.951 32.008	21.016 34.905	27.221 33.781

VII. CONCLUSION

Noise removal algorithm plays a vital role in medical imaging applications. Various noise removal algorithms at different noise levels has been analysed and its performance is evaluated for MRI brain medical images in Gray scale by both objective and subjective measures. So the denoising performance can be improved by choosing the better denoising techniques. From this study, the results showed that Median filter and bilateral filter gives desirable results with higher PSNR value for MRI image denoising. The result is also supported by previous related studies which has been tested on different modes of images.

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