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Detection of Brain Tumour in Medical Images Using Pre-Processing Techniques.

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ABSTRACT

This paper involves the detection of brain tumour using pre-processing. Pre-processing is a basic tool in medical image processing. This includes a pre-processing techniques and algorithms used in tumour detection. By using pre-processing techniques and algorithms. We can improve the visual appearance of images and also can improve the changes of datasets. Under pre-processing, so many techniques are there which can be used for tumour detection such as image resampling, Grey scale contrast improvement, noise removal, mathematical calculations and human corrections. For removing noise in the image we can use filters such as median, mean, wiener and Gaussian filters. After filtering, the image quality metrics can be measured using dataset images. Magnetic resonance imaging (MRI) is the primary imaging technique for detecting the brain tumour progression before and after surgery.

Keywords: Pre-processing, dataset, filters, image quality metrics, MRI images.

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INTRODUCTION

Medical imaging has a tremendous position in analysis and diagnosis of mind tumors, which has helped to manage and lessen the consequences of the disease. Magnetic resonance imaging is one of the most famous medical imaging strategies. This is due to the fact that MRI does not use ionizing radiation and able to displaying diverse tissues at excessive resolution with properly assessment and Also it produces multiple photos of the same tissue place with exceptional assessment visualization abilities by applying one of a kind image acquisition protocols and parameters [1]. Treatment of brain neoplasms is in near relationship to the knowledge of the volume and degree of neoplastic infiltration. Therefore the quantification and spatial localization of neoplastic tissues are of greatest Significance for prognosis, treatment planning and therapeutic monitoring. Brain tumours detection and tissue characterization is normally based totally on Magnetic Resonance Imaging (MRI) which offers a brilliant way for assessing the disease evolution and efficacy of remedy [2]. The contemporary exercise of indexing and retrieving these medical images is normally based on affected person images, identification marks, key points in the images and referencing features. Unluckily, this does not permit users to retrieve similar meaningful images. If those tumors had been segmented, the databases may be indexed first based on numerous elements of the tumour, which include its size, location and type, nicely indexed databases can help developed as they are seeking to decide the increase patterns and different properties exhibited by means of brain tumours [3].

Existing Method

There are two existing methods of brain tumour detection in image processing. They are fusion based and canny based methods.

Fusion based:

In this method, we will overlap the train image of the victim over a test image of the same age group so that we can easily detect the brain tumour.

Demerits:

- Overlapping creates complexity due to different dimensions of both the images.
- It is a time consuming process.

Pre-processing: It is a common name for operations with images at the lowest level of abstraction both input and output is intensity images. Its main objective is to improve the medical image binary data that hides all the noises or enhances required image features which are needed for further processing.

Four different types of image pre-processing methods based on the size of the pixel that is used for the calculation of new pixel brightness:

1. Image Pixel brightness transformations
2. Medical image Geometric transformations
3. Pre-processing methods that use a local neighbourhood of the converted pixel
4. Image retrieval that requires information about the whole image.

Structured diagram:

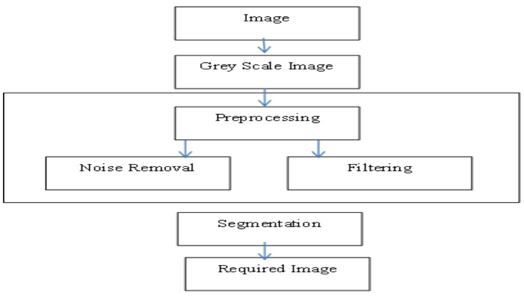

Fig.1: Process Diagram

Proposed method

Image pre-processing can appreciably boom the reliability of an optical inspection. Numerous filter operations which accentuate or decrease some image details permit an easier or quicker assessment. Filter contains several image filters for image optimization such as miscellaneous filters for edge enhancement, noise suppression and character modification.

Filters:

Filters used in this pre-processing technique are:

a. Median filter
b. Wiener filter
c. Mean filter
d. Gaussian filter

Now let's have a brief explanation about these filters.

Median filter:

In signal processing, its miles often applicable which will carry out some type of noise reduction on an photograph or signal. The median filter out is a non-linear digital image filtering approach, regularly used to cast off noise. Such noise discount is a normal pre-processing step to enhance the consequences of later processing (for instance, side detection on a picture). Median filtering could be very extensively utilized in digital photograph processing due to the fact, under certain conditions; it preserves edges while eliminating noise.

Algorithm Description:

The aim of the filter named median is to go around in the medical image signal input, replacing each input with the resulting median of successive entries. The pattern of images is referred to the "domain", which slides all the by way of entry, over the total information. For 1D signal, the most suitable window is just the first few and next entries, whereas for 2d signals containing photos, more complicated domain patterns are feasible. Observe that if the domain has a typical number of entries, then the median is directly defined: it detects just the middle values after all the entries within the domain are entered numerically. For a good range of entries, there are a couple of possible medians.

Wiener filter:

In medical image signal processing, it is a filter used to distribute an analysis of a preferred or final random process by linear time invariant (LTI) ,removing of a detected noisy elements, assuming recognized desk bound sign and noise spectra, and more noise. The Wiener filter minimizes the mentioned rectangular blunders among the envisioned random technique and the desired manner.

Description:

The aim of the Wiener filter is to find the graphical analysis of an input image signal that uses an appropriate signal as input and filtering that acknowledged image signal to provide the estimate of an output. Immediately, the regarded signal may provide an unknown signal of result that has been exploited through additional noise. The Wiener filter can be used to remove the noises from the exploited signal to provide an analysis of the referenced signal. The Wiener filter is primarily based on a comparison technique, and an extra graphical account of the principle is given inside the Minimum Mean Square Error (MMSE) analysis .Standard filters are designed for getting desired frequency response. However, the layout of the Wiener filter takes a distinct method. Among them one method is required that how the image spectral properties of the unique image signal and the noise, and the other seems the linear time-invariant filter whose output could come as related to the unique sign maximum.

Assumption: sign and noise are standard linear approaches with known spectral images or regarded similarities and move-correlation

Requirement: The filter must be physically realizable.

Overall performance criterion: minimal imply-rectangular errors (MMSE)

This filter is frequently used inside the method of DE convolution; for this utility, see Wiener DE convolution.

Mean filter:

In this filtering, 3x3 sub-regions is scanned over the entire image and at each position the centre pixel is replaced by the average value.

Gaussian filter:

In image processing, a Gaussian filter is the end result of filtering an image via Gaussian characteristic. It is a broadly used effect in snap shots software, normally to decrease image noise and reduce detail. The visible impact of this filtering technique is a clean filter relative to that of viewing the image through a semi -transparent display screen, fairly exclusive from the broken effect produced through an out-of-attention lens or the shadow of an item under standard illumination. Gaussian smoothing is also used as a pre-processing stage in laptop vision algorithms which will enhance image systems at exclusive scales, see scale area illustration and scale area implementation. Mathematically, making use of a Gaussian filter to an image is similar to convolving the photograph with a Gaussian function. With the aid of comparison, convolving via a circle, could more correctly reproduce the broken effect. Since the Fourier remodel of a Gaussian is any other Gaussian, applying a Gaussian filter has the effect of decreasing the image's high-frequency elements; a Gaussian filter is normally a low bypass filter.

Image Quality Metrics:

MSQE:

MSQE stands for Mean square quantisation error. It is defined as

$$\text{MSQE} = E[(x-\hat{x})^2]$$
$$= \int_{t_0}^{t_k}(x-\hat{x})^2\, p(x)dx$$
$$= \sum_{i=1}^{k}\int_{t_{i-1}}^{t_i}(x-q_i)^2\, p(x)dx \qquad (1)$$

In this conversion process, analog indicators in a continuous variety of values are converted to a discrete set of values by means of comparing them with a series of thresholds. The quantization errors of a sign is the distinction among the authentic continuous price and its discretization, and the suggest rectangular quantization error (given some probability distribution on the enter values) is the expected cost of the rectangular of the quantization errors.

PSNR: It stands for Peak signal - to – noise ratio. It is equal to the maximum possible value of a signal divided by the power of distorting noise that affects the quantity of its representation. PSNR is usually expressed in terms of the logarithmic decibel scale.

$$\text{PSNR} = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right) \qquad (2)$$

Where the MSE (Mean Squared Error) is,

$$\text{MSE} = \frac{1}{mn}\sum_{0}^{m-1}\sum_{0}^{n-1}\|f(i,j)-g(i,j)\|^2 \qquad (3)$$

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NCC

Abbreviation is Normalized Cross-Correlation. In digital image processing, programs are introduced to identify the brightness of the image and can template ranges, because lights and referenced conditions, the input medical images can be first normalized, then that is normally carried out in next further steps to subtract the referenced and dividing through the usual deviation. This is the pass-correlation of a template, t(x, y) with a sub image f(x,y) is

$$\frac{1}{n}\sum_{x,y}\frac{(f(x,y)-\bar{f})(t(x,y)-\bar{t})}{\sigma_f\sigma_t} \qquad (4)$$

Where n is the number of pixels in $t(x,y)$ and $f(x,y)$, $\bar{f}$ is the average of f and σ_f is standard deviation of f. In functional analysis terms, this can be mentioned as the dot product of two normalized vectors. That is, if

$$F(x,y) = f(x,y) - \bar{f}$$

And

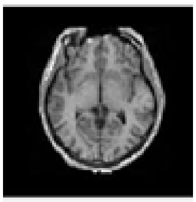
$$T(x,y) = t(x,y) - \bar{t} \qquad (5)$$

NAE:

Normalized Absolute Error is minimum value among the variance between the input medical image and the image obtained after normalisation.

RESULT

The following image is obtained by executing the image with matlab algorithm; the affected areas of brain will be identified using the image quality parameters.



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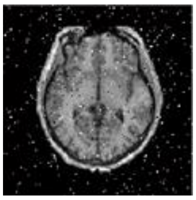

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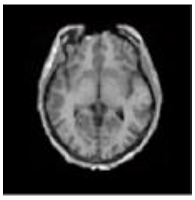

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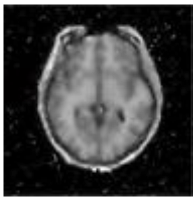

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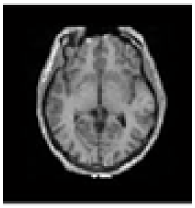

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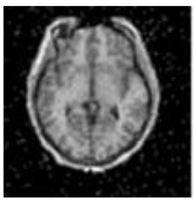


(f)

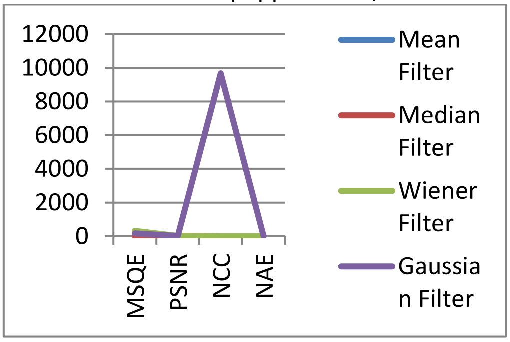
(g)

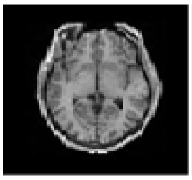
Fig.2: (a) Original image (b) Image with salt and pepper (c) Image after applying median filter (d) Image after applying wiener filter (e) Image after applying mean filter (f) Image after applying Gaussian filter

TABLE 1. Dataset values for image with Salt and Pepper after applying these filters:

Filter	MSQE	PSNR	NCC	NAE
Mean Filter	183.166	25.5024	0.972	0.1519
Median Filter	0.6265	29.066	0.9001	0.0585
Wiener Filter	317.5423	23.1128	0.9608	0.1786
Gaussian Filter	168.6327	25.8614	9673	0.1538

Among all the filters used to remove the salt and pepper noise, Gaussian filter results best.





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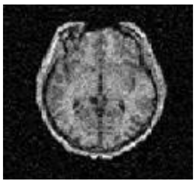

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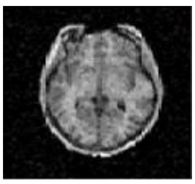

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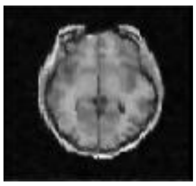

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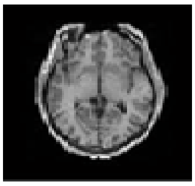
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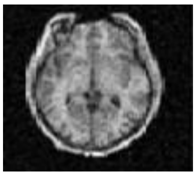
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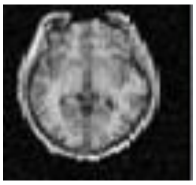
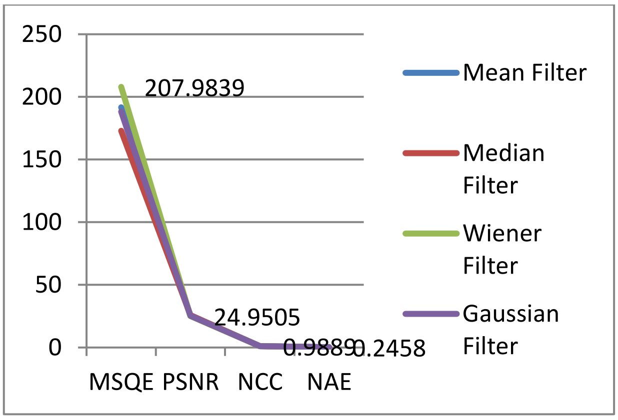

(g)

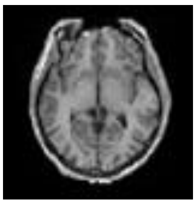
Fig.3: (a) Original image (b) Image with Gaussian noise (c) Image after applying median filter (d) Image after applying wiener filter (e) Image after applying mean filter (f) Image after applying Gaussian filter

TABLE 2. Dataset values for image with Gaussian noise after applying these filters:

Filter	MSQE	PSNR	NCC	NAE
Mean Filter	191.6773	25.3051	0.9693	0.2314
Median Filter	172.9258	25.7522	0.9717	0.1694
wiener Filter	207.9839	24.9505	0.9889	0.2458
Gaussian filter	188.2239	25.3841	0.9647	0.2321



Among all the filters used to remove the Gaussian noise , Wiener filter results best.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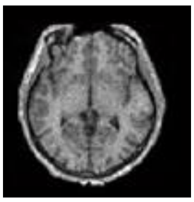
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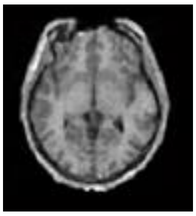
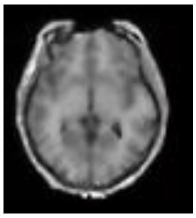


(c)



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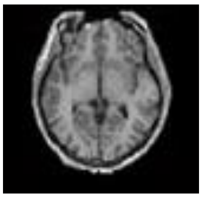

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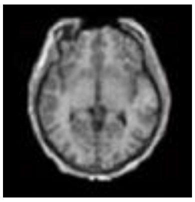

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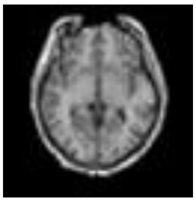
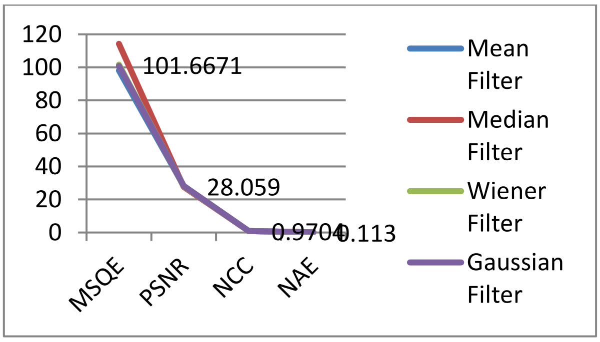


(g)

Fig.4: (a) Original image (b) Image with Poisson noise (c) Image after applying median filter (d) Image after applying wiener filter (e) Image after applying mean filter (f) Image after applying Gaussian filter

TABLE 3. Dataset values for image with Poisson noise after applying these filters:

Filter	MSQE	PSNR	NCC	NAE
Mean Filter	91.1203	28.5347	0.9697	0.0944
Median Filter	90.7705	28.5514	0.9742	0.0804
Wiener Filter	84.1843	28.8785	0.971	0.1035
Gaussian Filter	66.3894	29.9111	0.9747	0.082



Among all the filters used to remove the Poisson noise, median filter results best.

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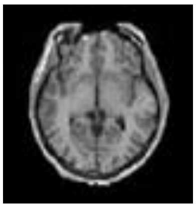

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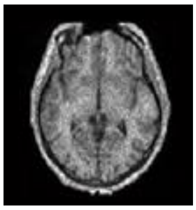

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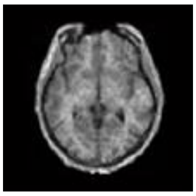

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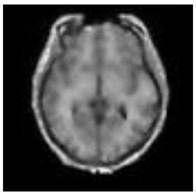

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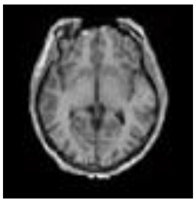

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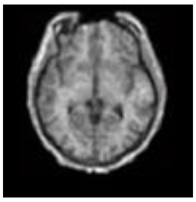

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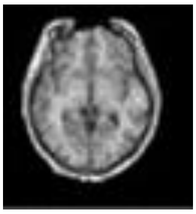
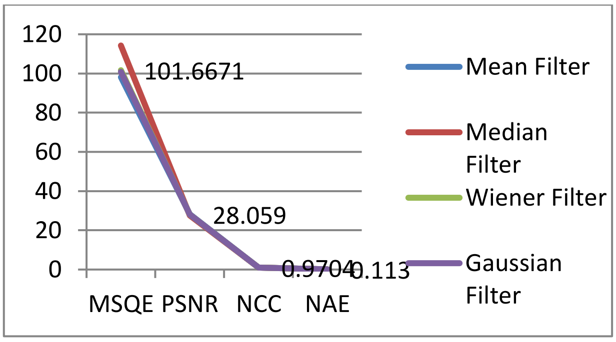


(g)

Fig.5: (a) Original image (b) Image with Speckle noise (c) Image after applying median filter (d) Image after applying wiener filter (e) Image after applying mean filter (f) Image after applying Gaussian filter

TABLE 4.Dataset values for image with speckle noise after applying these filters:

Filter	MSQE	PSNR	NCC	NAE
Mean Filter	98.1117	28.2136	0.9694	0.101
Median Filter	114.2635	27.5517	0.966	0.0993
Wiener Filter	101.6671	28.059	0.9704	0.113
Gaussian Filter	100.8399	28.0945	0.9646	0.104



Among all the filters used to remove the speckle noise, median filter results best.

CONCLUSION

Thus the brain tumours is detected using pre-processing techniques in image processing and image quality metrics are measured using dataset images in matlab. I will develop this in next journal.

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