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Diagnosis and prediction of Brain malfunction Using Hybrid Segmentation Methods

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Abstract: Automatic image segmentation turns severely crucial for the detection of tumor in the processing of medical image. Semi automatic and Manual techniques of segmentation require immense knowledge and time. These drawbacks however has been overcome by the hybrid segmentation, yet there are requirements to develop many techniques that are appropriate for the medical image segmentation .Hence, we generated image segmentation based on hybrid approach making use of the features of threshold segmentation technique and region growing techniques combined. This is followed by the pre-processing stage to give away an accurate extraction of brain tumor with the help of (MRI) Magnetic Resonance Imaging. The threshold segmentation method is made use of for the segmentation. Four types of noise are undergone in the segmented image: Gaussian noise, salt and pepper noise, Poisson noise and speckle noise which are influenced in brain smear image and they are removed using the filters of four types : median filter, mean filter, wiener filter and gaussian filter to test the efficiency of the variety of filters over the various kinds of noise. To estimate the parametric values we can make use of PSNR , NAE ,MSE and NK .

Keywords – Segmentation,Image Processing,Image Filtering.

I. INTRODUCTION

The hybrid segmentation technique [22], combining two or more techniques give away an efficient result which is far better than the algorithms of segmentation which works separately. This is made possible in the Image Processing field mostly under the area of segmentation of the medical image. Image segmentation refers to the separation of the objects from its background [1]. This segmentation of the image could be based upon the grey scale, texture, color, motion and depth. In the feature extraction

process, statistical data are calculated based on the gray scale level matrix having distinct directions and distance[2]. After the feature extraction process, the special features that are used for the classification is selected [16]. Thus image processing works as the heart of the classification technique. The proposed system majorly focuses on the medical imaging for the extraction of tumor, especially in MRI images [3]. It has accurate positioning of the hard and soft tissues, high-resolution, and is most suitable in the brain tumors diagnosis. Hence, this kind of imaging is more adoptable for the identification of the brain lesions or tumor [4] [5]. Brain tumor is an unusual white tissue which is differed from the usual ,normal tissues. This could be found out by the tissue structures .Tumors generally consist of holes or has the appearance of white solid tissues. Hence, the threshold segmentation is combined intently with the growing region for the improvement of the result [17]. The RF Random forest is applied during the

segmentation process of the brain, in order to classify the voxels as three different components, cerebrum, cerebellum and brain stem. four categories [6].. The usual method of random forest consists of two main disadvantages in the segmentation of the medical image: 1. A large pool feature with a lot of poor features may affect the accuracy of segmentation. 2. Voting equally by each tree is not the better way to generate the result of classification. Weighted voting and feature selection are applied in this paper, in order to overcome the problems for brain components segmentation [7]. Picture noising is an irregular variety of shading or shining of data in the picture and is also a part of electronic clamor. This could be delivered by the hardware and sensor of a scanner or by making use of a computerized camera. Four types of noise are undergone in the segmented image [8]: Gaussian noise [12] [18], salt and pepper noise, Poisson noise and speckle noise which are influenced in brain smear image and they are removed using the filters of four types [11]: median filter, mean filter, wiener filter and Gaussian filter to test the efficiency of the variety of filters over the various kinds of noise [19]. To estimate the parametric values we can make use of Normalized Absolute Error, Mean Square Error, Peak Signal Noise Ratio and Normalized Correlation [9] [10].

II. RELATED WORK

a. BFR Algorithm

One of the emerging method in clustering algorithm is BFR (Bradley Fayyad Reina) [13] [14] Datasets that are congregated are classified into two clustering algorithms namely 1) hierarchical clustering 2) point clustering. BFR is a point clustering algorithm which avoids multiple copies of the database. BFR is processed by retrieving the database from Gaussian distribution and normally distributed across centroid[21].

The main idea behind BRF algorithm is to maintain the clusters in the main memory. The three sets that are involved in BRF includes Discarded Set(DS), Compressed Set(CS) and Retained Set(RS). Discarded set points which are present in the cluster and are further stored in the disk. They are placed in the main memory. Compressed sets are mini clusters points close to each other but not close to any cluster. They don't fit into big clusters and are kept within the disk.

b. SOM Algorithm

Tumor images are identified using a technique named Self Organizing Map [14]. The process begins when the random variables are taken for initial weight vector. The main advantage of SOM is visualizing low-dimensional views of high-dimensional data so that the dimensionality and clustering of an image is reduced. The following steps are proposed on how SOM algorithm works.

Step 1: Processing of SOM commences when random variables are chosen for initial weight vector.

Step 2: The processing includes grabbing of an input vector from the input image.

Step 3: Each input data in the input set is traversed and the neuron that wins is found.

Step 4: Finally the drawing of vector from input image is repeated.

III. PROPOSED WORK

Proposed work is depends on Hybrid Segmentation and Classification Process in a brain image . The brain is partitioned into three different components, cerebrum, cerebellum and brain stem. Segmentation is based on the adaption result of the volume of interest of the brain. The Active Appearance model (AAM) method is used to identify the localization of the brain. The AAM is basically used in the computer vision such as face recognition and organ localization. However, typical AAM searches the whole image which is inefficient especially for large volume image. The AAM traverse around the centre of gravity of brain instead of the whole image thus improving the accuracy and efficiency of AAM. In segmentation process of brain components, the (RF) Random forest method is used. During the segmentation process of the brain, the (RF) Random forest method involves in the classification of voxels into three categories [15]: cerebrum, cerebellum and brain stem. The conventional random forest method has two major disadvantages in medical image segmentation: A huge feature pool containing many poor features may affect the accuracy of the segmentation. Producing classification result by equal voting of each tree is inappropriate. These problems for brain components segmentation can be avoided by feature selection and weighted voting. In addition to that the multithreading technology acts as a catalyst to speed up the segmentation process.

3.1 Types Of Noise

Picture commotion is the arbitrary variety of the splendor or shading data in the representation and is generally a kind of electronic agitation. This could be delivered or given through the hardware and sensor of a computerized camera or scanner. Picture clamor can be created in a film grain and inside the unavoidable shot commotion of a phenomenal photon finder. It is a method which is undesirable and produced from picture catch which include spurious and incidental realities[20].

a. Salt And Pepper Noise

Salt and pepper is a kind of noise at times noticeable on images. It offers a safe and careful approach on noise reduction and for these kinds of noises it makes use of the median or morphological filter. For reducing both the salt and pepper noise, but not the both, a contra harmonic mean filter will also be effective. This noise is also considered as impulsive or fat tail distributed or spike noise.

b. *Gaussian Noise*

Gaussian noise is a noise which is statistical having the (PDF) probability density function equal to that of a typical distribution, which is at times known as the gaussian distribution. At different phases, the values that the noise can take on are called gaussian-disbursed.

c. *Speckle Noise*

Speckle noise is the granular noise which exist inherently and diminish the standard of the (SAR) synthetic aperture radar, active radar, medical ultrasound and hence the optical coherence pictorial represents the image. The monstrous majority of surfaces, artificial or standard area unit completely arduous on the size of wavelength.

d. *Poisson Noise*

Poisson noise sometimes called photon noise , is a basic type of uncertainty associated with the dimension of light , inherent to the quantized nature if mild and the independence of photon detections.

3.2 Types Of Filters

The filtering technique is used for enhancing or modifying an image. For example, filtering of an image can be done to emphasize or remove certain features. Operation of an image process is done with the use of filters which includes sharpening, smoothing, and edge enhancement.

a. *Mean Filter*

A simple, intuitive and an easy to enforce method of smoothing of picture is mean filtering i.e. it decreases the quantity of depth variant between pixels. It is used to lessen the noise in the image.

b. *Median Filter*

The advanced separation method used to uproot commotion is by the use of the nonlinear median filter. Such commotion diminishment is a run of the mill pre-preparing venture to enhance the aftereffect of later handling (for instance, edge discovery on a picture).

c. *Gaussian Filter*

A Gaussian channel is a channel whose drive reaction is a Gaussian do in hardware and sign handling. Gaussian channel have the properties of getting no overshoot to a stage capacity information while minimizing the fall time and ascent. This conduct is firmly connected to the truth that the Gaussian channel has the negligible conceivable gathering stretch. It is thought about the right time region sift through, these houses are required in regions reminiscent of virtual telecom structures and oscilloscopes.

d. *Wiener Filter*

the wiener filter is used in the signal processing, to produce an estimate of the target random system by using (LTI) linear time-invariant filtering of an found noisy system, assuming known noise spectra , stationary sign and additive noise. The imply square error occurring in between the preferred method and the estimation random system can be minimized with the use of wiener filter.

IV. EXPERIMENT AND RESULT

For the segmentation process, a set of different brain images are taken. The image is first segmented through the AAM and (RF) Random Forest model. It is then subjected with various kinds of noise. Every single image with the noise added is subjected to various types of filters.
The following algorithm explains brain segmentation from the input brain image
ALGORITHM: Hybrid segmentation method with slider control
INPUT: Brain image of size m x n
OUTPUT: Segmented brain image

1. Let I be the input image .

2. The RGB image is converted into a grey scale image .

3. Use the gradient magnitude as the segmentation function.

4. Mark the foreground objects .

5. Compute the Background markers .

6. Compute the watershed transform of the segmentation function .

7. Calculate a mean value of input image , say Tm .

8. Let $p_0, p_1, p_2, \ldots, p_n$ be the pixel values ; g be the grey scale value and N be the maximum pixel value of the image .

9. Threshold value t is assigned to slider control. Calculate the mean pixel value based on two conditions namely, less than and greater than the threshold value independently .

10. Visualize the result.

The original image is compared with filtered image and the results are shown fig 1 and Image Quality Metrics for Various Filters Applied In Salt and Pepper Noise.

Table 1 Image Quality Metrics for Various Filters Applied In Salt and Pepper Noise

	MSQE	PSNR	NCC	NAE
Mean Filter	139.740	26.6776	0.9745	0.2117
Median Filter	23.9538	34.3371	0.9637	0.0615
Wiener filter	321.420	23.0601	0.9570	0.2520
Gaussian Filter	123.627	27.2096	0.9694	0.2157

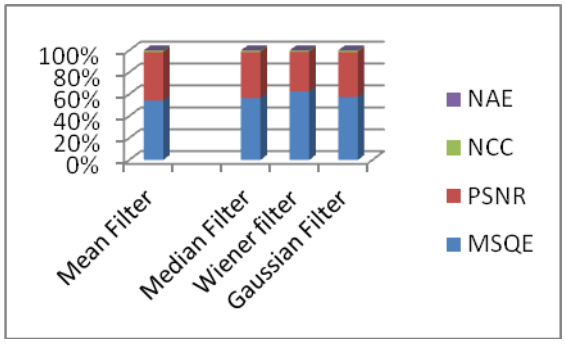

Fig 1 Image Quality Metrics for Various Filters Applied In Salt and Pepper Noise

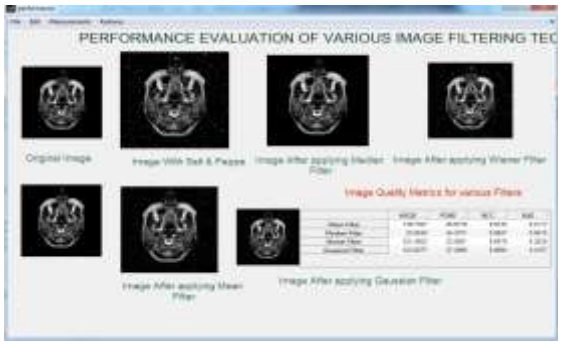

Fig.2.Performance Evaluation Of brain Image using Salt and Pepper Noise

Fig 1 shows the graphical representation of Table 1 and fig 2 show the Performance Evaluation Of brain Image using Salt and Pepper Noise

Table 2 Image Quality Metrics For Various Filters Applied In Gaussian Noise

	MSQE	**PSNR**	**NCC**	**NAE**
Mean Filter	143.7919	26.5535	0.9769	0.3759
Median Filter	104.8239	27.9262	0.9802	0.2398
Wiener filter	162.0831	26.0334	0.9755	0.4040
Gaussian Filter	141.4453	26.6249	0.9719	0.3769

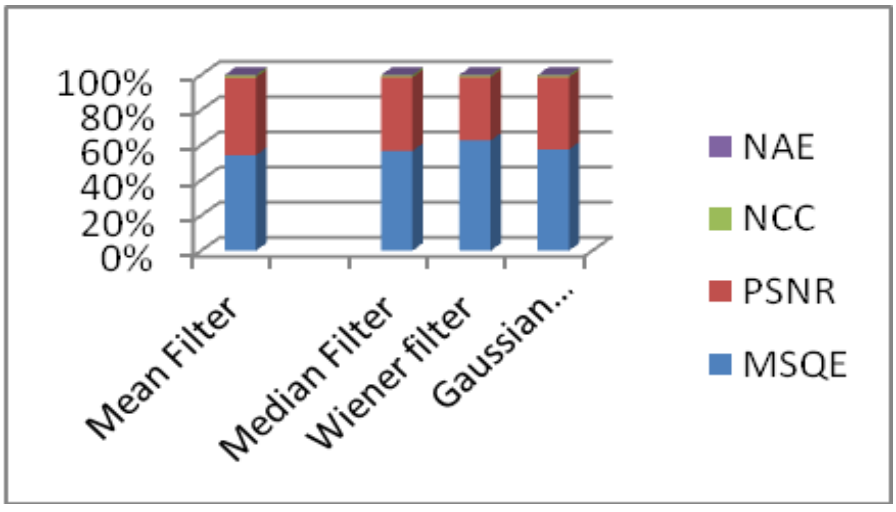

Fig 3 Image Quality Metrics For Various Filters Applied In Gaussian Noise

Fig 4. Performance Evaluation Of brain Image using Gaussian Noise

Fig 3 shows the graphical representation of Table 2 and fig 4 show the Performance Evaluation Of brain Image using Speckle Noise

Table3 Image Quality Metrics For Various Filters Applied In Speckle Noise

	MSQE	**PSNR**	**NCC**	**NAE**
Mean Filter	39.4629	32.1689	0.9734	0.1001
Median Filter	43.0833	31.7877	0.9706	0.1001
Wiener filter	53.6478	30.8353	0.9777	0.1261
Gaussian Filter	44.4006	31.6569	0.9682	0.1063

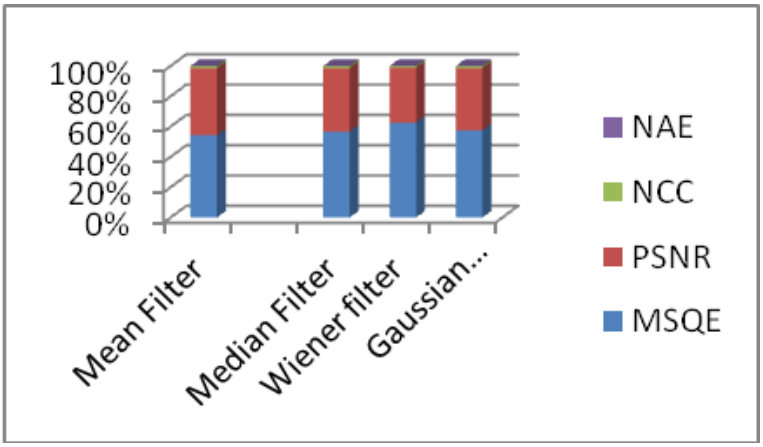

Fig 5 Image Quality Metrics For Various Filters Applied In Speckle Noise

Fig 6. Performance Evaluation Of brain Image using Speckle Noise

Normalized absolute error indicates how different the de-noised image is when compared to the original, with the value of zero being the perfect fit. A large NAE value represents poor image quality. Fig 5 shows the graphical representation of Table 3. It is observed that the median filter gives the highest PSNR and the lowest MSE and NAE values against salt-and-pepper noise, thereby establishing that the performance of median filter is better than that of the others. When the NCC approaches closer to 1, it shows that the equivalent filter is an optimal alternative that effectively removes salt-and-pepper noise.

V. CONCLUSION

This paper segments the brain from the non-segmented portions and compares the performance of the four filters mean filter, Gaussian filter, median filter and therefore the wiener filter to de-noise the pictures subjected to four sorts of noises: salt and pepper, Gaussian noise, speckle noise and Poisson noise . From the result shown higher than it's clear that median filter shows

its best performance over salt and pepper noise and wiener filter shows sensible performance over Gaussian, Poisson and speckle noise. Thus wiener filter is associate degree optimum filter which will be applied to medical pictures. For the segmentation process, a set of different brain images are taken. The image is first segmented through the AAM and (RF) Random Forest model. It is then subjected with various kinds of noise. It is conferred that the proposed model works better for the brain segmentation.

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