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Assessment and filtering of mental state Image using Avalanche Oozing (A-O) Algorithm

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ABSTRACT- Image filtering plays very important role in every field, for correct assessment of any condition. Condition may be related with medical field, satellite data or any written data evaluation. Noise reduction is a process through which a received image visibility can be enhanced by removing unwanted effect from that image by using various algorithms. This paper encompasses the filtering of biomedical image using Avalanche Oozing (AO) algorithm. First section of this work includes the general introduction of image analysis, after that the various types of image noises was described. Then problem formulation and objectives of this paper have been listed. Further results of predefined and A-O method have been compared by using various image.

Keywords: Avalanche Oozing (A-O), Multiplicative Noise, Noise.

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1. INTRODUCTION

With the advancements in technology, adequate image analysis becomes one of the major concerns these days. Noise filtering from medical images helps a lot for analysis medical images from every aspect for proper diagnosis. Noise in an image actually changes the image pixels intensity from true pixel value. The assessment of noisy images is done through the comparison between the various parameters of noisy images and the same parameters results produced after the filtering of noisy image (Tasdizen et al., 2005).

Noise in an image is actually an unwanted effect that degrades the visual quality of an image. Usually, the noise is appended during the acquisition of an image and transmission of an image from source to destination point through wireless or wired transmission media. sources that generate the noises in an image i.e., inadequate light intensity and presence of dust particles on scanner screen etc.

The various types of noise that corrupt an image is categorized as Gaussian noise (Amplifier noise), Salt & Pepper noise (impulse noise), shot noise, uniform noise (Quantization noise), isotropic noise, periodic noise and speckle noise.

1.1 Theory of Image Noise

Please use Noise is the unwanted effect that comes into an image during capturing or transmission process. The noise in an image degrades the quality of an image. This degradation is equal to the difference between original image and noisy image.

Gaussian Noise: In Gaussian noise, the value of each pixel gets deviate by a small amount from its true value. Gaussian noise is statistical noise having a probability distribution function (PDF) (Kaur and Singh, 2011).

Salt and Pepper Noise: The main source of Salt & pepper noise is the presence of dust in the camera and overheated or defective elements. This type of noise is known as impulse noise or Salt & Pepper noise. It is actually mis visualization of pixels. Due to this noise resultant image contains black pixels on white background and white pixels on black background (Lal et al., 2012). This type of noise generally affects a small range of image pixels. When this type of pixel is visualized, it looks like black and white dots. Actually, in this noise pixels and background color is opposite. This type of noise can be minimized by taking proper care of image capturing objective.

Shot Noise: Shot noise is arising due to quantum fluctuations of photon. As for generating this type of noise photon plays very important role so it also known as photon shot noise. In addition to photon shot noise, there can be additional shot noise from the dark leakage current in the image sensor; this noise is otherwise known as "dark shot noise" or "dark-current shot noise".

Quantization Noise (Uniform Noise): The quantization noise arises when the input image pixels are approximated during image acquisition. It is uniformly distributed all over the image so also known as uniform noise.

Isotropic noise: This noise results from a uniform distribution of point noise sources over all directions in the far field.

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Isotropic noise is the random noise radiation which arrive a location from all directions with equal intensity.

Speckle Noise (Multiplicative Noise): Speckle noise also known as granular noise or Multiplicative Noise. This kind of noise occurs due to the random fluctuation of satellite captured images.

Periodic noise: This type of noise usually occurs due to electrical or electromechanical interference during the image capturing process (Gonzalez and Woods, 2007). The resultant image of periodic noise will look like a repeating pattern has been added on top of the original image.

1.2 Proposed work & Problem Formulation

In medical images, ground truth is one of the main concerns for proper diagnosis of any upset condition of body. Many researchers have developed many algorithms for image dilution but the not achieved adequate image quality. At the same time these methods are not successful for generating the adequate value of various image parameters.

1. In this paper, Avalanche Oozing algorithm is used for upgrading image visualization. This algorithm works on multiplication factor. As the simple filter, reduce noise from an image then the same image filtered again and again till it get the same parametric value as of original image.
2. For the implementation of A-O algorithm, MATLAB software is used.
3. This work covers the following objectives:
4. Analyze the effect of noise by calculating various image indices. The various image indices that to be calculating for evaluating noise effects are shown in Table 1.
5. Apply Avalanche Oozing algorithm on corrupted image
6. Compare the Avalanche Oozing pictorial results with predefined filter result.
7. Calculate same image indices after the application of proposed strategy.

1.3 Methodology

Step1: Take sample input

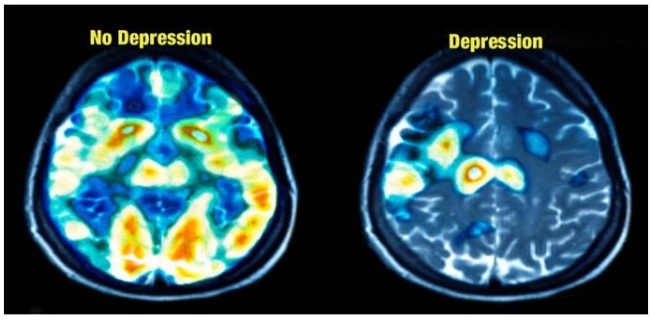

Figure 1: Sample input

The sample input includes the normal mind condition and condition after depression as shown in *figure 1*.

Step2: Add noise in it

Then add noise in the original input image. The results after adding noise in pure image is shown in *figure 2*. The main sources of noise in biomedical images are the presence of dust particles on the image capturing device

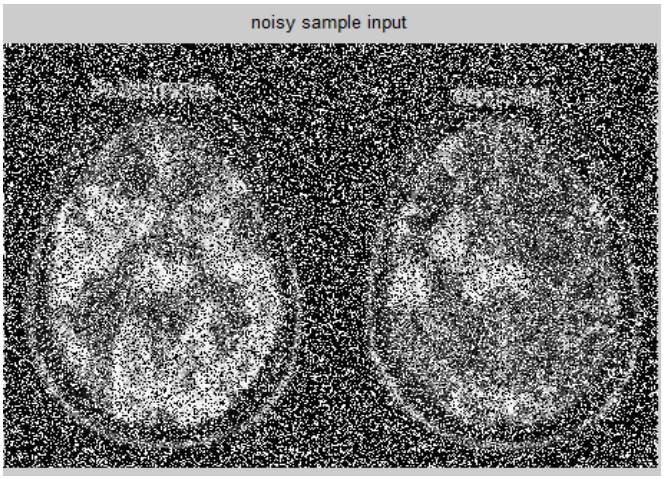

Figure 2: Sample input with noise

The above figure depicted the results that come after adding noise in sample input by implementation through MATLAB.

Step3: Calculate noisy image indices after the application of predefined filter.

This step includes the various parameters that will be calculated after the application of predefined filter. Few of these parameters totally depend on the difference between the noisy image, actual image and filtered image. The various parameters that will be calculated in this research work are shown in *table 1*.

Table 1. Image indices (Tasdizen et al., 2005; Tasdizen et al., 2005)

S. No	Parameter Name
1	Image Quality Index
2	Mean absolute error
3	Mean square error (MSE)
4	SNR
5	PSNR
6	RMSE
7	SSIM
8	Standard Deviation (SD)

Image Quality Index: It is mathematically defined as the image degradation modeling relative to the original image as a combination of three factors: loss of correlation, luminance distortion, and contrast distortion.

Signal-to-noise ratio: The SNR measures the sensitivity of an imaging system. In other words, it is defined as the ratio of average signal value to the standard deviation.

MSE & PSNR: These two error metrics are used for comparing compression algorithm. The MSE is the cumulative squared

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error between the filtered and compressed image and the pure image, whereas PSNR is a measure of the peak error.

Root mean square error (RMSE): It is a measure used to evaluate how well a technique to reconstruct an image performs relative to the original image.

SSIM: The structural similarity (SSIM) index is used to measure the similarity between two images. In this work SSIM check the similarity between noisy and filtered image.

Step4: Apply predefined and proposed image dilution methods on noisy image and check the pictorial results.

Step5: Calculate noisy image indices as defined in step 3 after the application of proposed method

2. RESULT AND DISCUSSION

The result of this work after the implementation of *step 3* and *step 4* are as follows

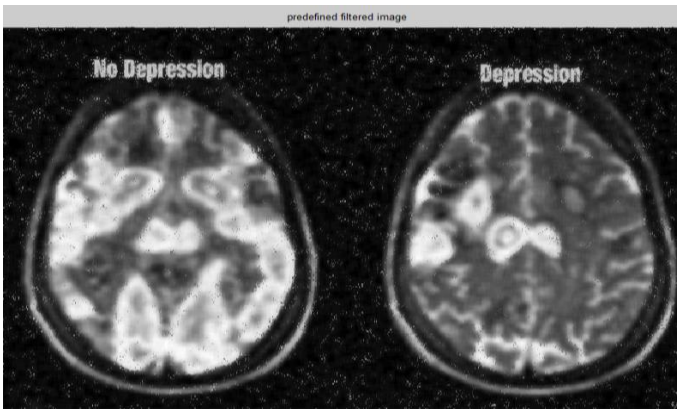

Figure 3: Predefined filtered sample noisy image

Figure 3, showed the filtering results of predefined filter. By using this type of filter, it's very tough to differentiate two different states of mind, if the noise density is very high.

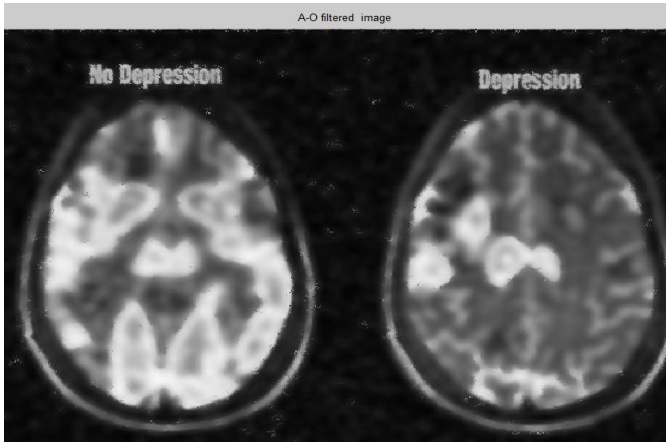

Figure 4: A-O filtered sample noisy image

Table 2: Indices comparison of Predefined filtering and A-O Oozing method

Parameter Name	Predefined algorithm	A-O algorithm	Improvement by A-O method
Image Quality Index	0.33392	0.39696	0.06304
Mean absolute error	0.07206	0.05104	0.02102
Mean square error (MSE)	0.0091	0.0102	0.0011
SNR	69.2383	68.7531	0.4852
PSNR	68.534	68.0488	0.4852
RMSE	1.67E-04	1.77E-04	-9.59E-06
SSIM	0.7893	0.879	0.0897
Standard Deviation (SD)	0.2549	0.257	0.0021

In *table 2*, Improvement by A-O method column represented it very clearly that the A-O algorithm improved the various image parameters. Above table, represent improvement up to 48% in SNR and PSNR. At the same time SSIM is upgraded by factor 8% and Image quality approximately by 6%. Proposed algorithm works on multiplication factor.

3. FUTURE WORK

By application the various optimization algorithms, the multiplication process can be speedup which will yield the enhanced version of A-O algorithm. At the same time, A-O algorithm can be applied on satellite captured images or primary scripture of various languages. As well as the indices level also be upgraded through hybrid techniques.

4. CONCLUSION

Compared to different algorithm available for image filtering, it is concluded that the A-O algorithm has yield more better results over predefined image filters. At the same time, it is also found that A-O algorithm is suitable for all type of noises. Even A-P technique also upgrades visual and parametric indices of noisy images up to satisfied level. In the indices table of predefined and A-O method, it is concluded that the degradation level is more even after filtering through predefined filter, where there is very less degradation present after filtering through A-O algorithm. The A-O algorithm is works to diminish all kind of noises, at the same time it can provide good filtering results for high density of noise. The tabular results of A-O algorithm showed that this method is very suitable for up gradation in SNR, PSNR image factor. Through this method, 48% improvement achieved for these two indices.

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