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Analysis of various Noise filtering techniques for medical images

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ABSTRACT - *Noise represents unwanted information which effects image quality. The image capturing mechanisms may cause noise within the image. The noise causes distortion and leads to production of misleading information. Filtering is one of the strategies associated with noise handling. In order to tackle the noise issues by different filtering techniques are used like mean filtering, median filtering, Gaussian filtering etc. Noise handling mechanisms are analyzed in the current context and optimized strategy can be detected for parameter enhancement in future.*

Keywords: Image capturing, noise handling mechanism, filtering

1. INTRODUCTION

Image processing procedures considered as imperative part in medical image or picture to illustrative and recognition of scatters and screen the patient from this disorders. The image processing using as a piece of various applications in the restorative picture like Magnetic Resonance Imaging (MRI), Computerized Tomography (CT), Ultrasound imaging and X-ray images and so on. These applications are especially cost to the patient when it don't clear the reimaging is more cost for that, then the photo activity is one of picture preparing techniques to deal with this issue by less cost and fast. Medical images are ordinarily debased by commotion in the midst of picture acquirement and transmission process.

Medical images are regularly tainted by incautious, added substance or multiplicative noise because of various non-idealities in the imaging procedure. The noise usually ruins medical images by supplanting a bit of the pixels of the main picture with new pixels having luminance esteems close or identical to the base or most outrageous of the sensible component luminance extend. The recognizable evidence of type of noise in the medical image is done in two stages in the principal organize; a model is used to recognize the nearness of the impulsive noise. If the outcome of this lead is negative, the image or picture is then submitted to second period of another establishment with a particular true objective to recognize either the added substance or the multiplicative method for the noise. Noise may be caused due to transmission system or various environmental reasons that includes noises like Gaussian, Poisson, speckle and salt pepper noise. To remove noise filters are used like median filters, Gaussian filter, wiener filter that gives best result for all noises respectively.

1.1 VARIOUS TYPES OF NOISES

Salt and Pepper Noise

Salt and pepper noise is also known as impulse noise. This noise introduces white dots within the image and image clarity is lost. To solve the problems of salt and pepper noise, median filtering is commonly used [6].

Gaussian noise

Gaussian noise is introduced due to thermal or heat emitted through devise used to capture the image. The medium through which image is transferred could also cause the problem. Contrast related problem occurs due to this type of noise. Gaussian filtering mechanism is used to tackle the issues of Gaussian noise [7].

Shot Noise

This noise occurs due to malfunction of sensors. The sensor failure hence result this kind of noise that occurs in the darker regions of the image. Adaptive median filtering could be used to tackle such a noise [3].

Anisotropic Noise

This noise appears within the image through the orientation of image. In other words, if image is scaled than such noise appears within the image [4].

The noise removal is generally accomplished within pre-processing phase. After the pre-processing phase, generally segmentation takes place. Segmentation is used to divide the image into segments through which critical and non-critical regions are identified.

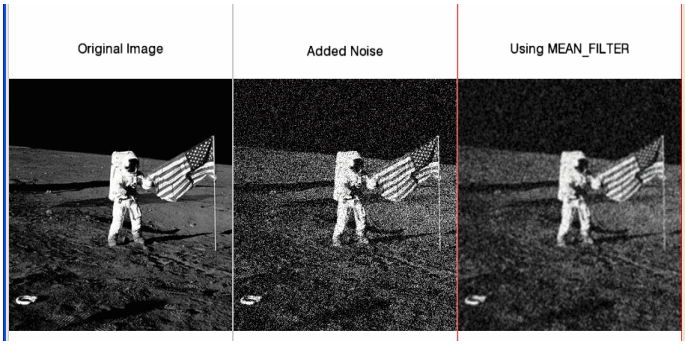
These are some of the noises introduced through the medium or through the acquisition mechanism. Next section describes the mechanisms used to tackle such noise from within the images.

1.2 VARIOUS TYPES OF FILTERING TECHNIQUES

There are various types of filter which are used to remove noise from medical images. These filters which are helpful for noise reduction discussed below:

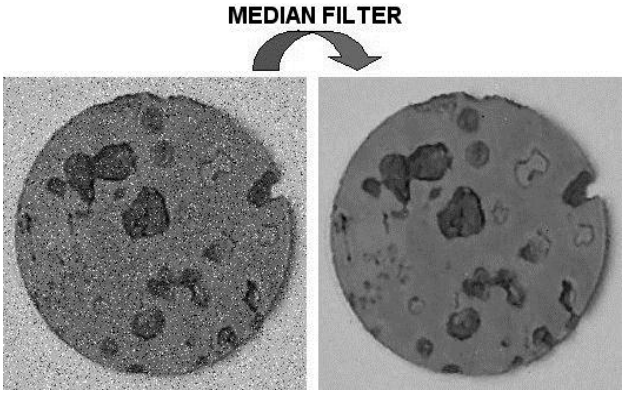
Mean Filter (MF)

Mean Filter (MF) is a straightforward linear filter, intuitive and easy to execute procedure for smoothing images, i.e. diminishing the measure of power variety between one pixel and the following. It is mostly used to lessen noise in images. Mean filtering is fundamentally to replace every pixel value in an image with the mean (normal) estimation of its neighbors, including itself. This filter is also known as low pass filter.



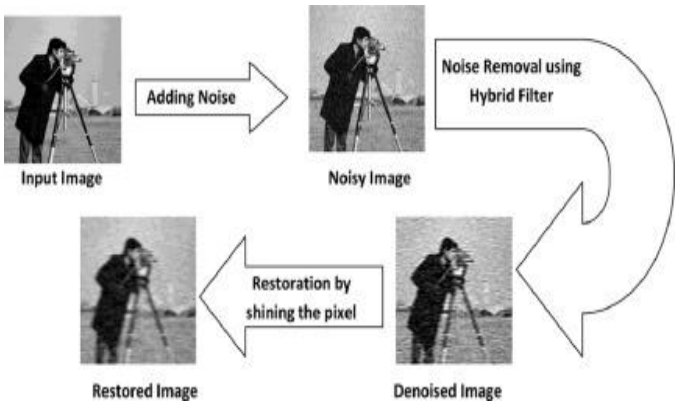
Median Filter (MF)

It is the non-linear filter.Median filtering is commonly used to tackle the impulse noise. The impulse noise is also known as salt and pepper noise. Median filter is one of the most common filters to tackle the issue of various types of noises and for this purpose continues modification to the median filter is made. In addition to standard median filter, there are weighted median filter, iterative median filter, recursive median filter, directional median filter, switching median filter, and adaptive median filter. Use of these filters depends greatly on the complexity of noise present within the image. Actually, the concentration of impulse noise on an image is varied because impulse noise is a random noise. Therefore, there are regions of the image with high level of corruption, and there are also regions with low level of corruption. For an effective noise filtering process, a larger filter should be applied to regions with high level of corruption. In contrast, a smaller filter should be applied to regions with low level of corruption. Because the size of the filter is adapted to the local noise content, this type of median filter is known as adaptive median filter.



Hybrid Median Filter (HMF)

The best-known order measurement filter in computerized image processing is the median filter. Hybrid Median filter is of nonlinear class that effectively evacuates impulse noise while edges are preserved. The hybrid median filter assumes a key part in image processing and vision. In correlation with fundamental form of the median filter, hybrid one has better corner protecting attributes. These filters are yet to be connected by analysts to evacuate the Gaussian noise in the medical images [5].



Weiner Filter (WF)

It joins both the degradation function and measurable attributes of noise into the reclamation procedure. The strategy is established on thinking about images and noise as irregular. It is expected that noise and the image are uncorrelated; that either has zero mean; and that the gray levels in the gauge are a linear capacity of the levels in the debased image.

Gaussian Filter

This filter is used in order to handle Gaussian noise. This filter also falls under the category of low pass filter. In this case, the signals having distorted values are blocked and continue signals are allowed to pass. Salt and pepper noise

can be tackled using this filtering mechanism. This is also known as Gaussian smoothening.

1.3 Applications of Filtering Techniques

Filtering techniques are used in various image processing tasks like to remove the blurriness of the image, noise present in the image, enhance the contrast of the image, smooth the image, sharp the images, edge enhancement and to emphasize certain features or remove other features. In medical sciences image processing plays a great role in enhancing the quality of the image in a great way. Because a little mistake in the view of image can cause a big trouble for the patient. So the pictures collected during MRI Scan, Ultrasonography, endoscopy, elastography, thermography and many more technologies should not contain noise in the images for the proper information regarding the disease of the patient. Biomedical science uses image processing for retrieval of images, analysis or modification of images for both diagnostic and therapeutic purposes.

2. Literature Survey

(Pilevar et al. 2013) The salt and pepper noise can also be handled by the use of signal and noise filter such as median filter. The median filter is used to handle noise present within the image. Problem starts to appear when temperature goes high. The pixels are electronic components which will be excited when they got heated. The excited pixels will emit energy and light is shown. Hence white level in the image is increased beyond requirement causing spikes within the image [9].

(Zhang et al. 2015) The algorithm based on low-rank matrix recovery to remove salt & pepper noise from surveillance video. Unlike single image de-noising technique, noise removal from video sequences aims to utilize both temporal and spatial information. By grouping neighboring frames based on similarities of the whole images in the temporal domain, we formulate the problem of removing salt & pepper noise from a video tracking sequence as a low- rank matrix recovery problem. The resulting nuclear norm and L1-norm related minimization problems can be efficiently solved by many recently developed methods. To determine the low-rank matrix, we use an averaging method based on other similar images [10].

(a.M et al. 2014) This paper describes the image representation using encoding mechanism. The encoding mechanism which is used is known as Discrete Cosine Transformation. The DCT transformation will use the concept of Fourier Transformation in order to perform encoding and then same process is used in reverse in order to perform decoding [1].

(Teodoro et al. 2013) Analysis of large pathology image datasets offers significant opportunities for the investigation of disease morphology, but the resource requirements of analysis pipelines limit the scale of such studies. Motivated by a brain cancer study, we propose and evaluate a parallel image analysis application pipeline for high throughput computation of large datasets of high resolution pathology tissue images on distributed CPU-GPU platforms. To achieve efficient execution on these hybrid systems, we have built runtime support that allows us to express the cancer image analysis application as a hierarchical data processing pipeline. The application is implemented as a coarse-grain pipeline of stages, where each stage may be further partitioned into another pipeline of fine-grain operations. The fine-grain operations are efficiently managed and scheduled for computation on CPUs and GPUs using performance aware scheduling techniques along with several optimizations, including architecture aware process placement, data locality conscious task assignment, data prefetching, and asynchronous data copy. These optimizations are employed to maximize the utilization of the aggregate computing power of CPUs and GPUs and minimize data copy overheads. Our experimental evaluation shows that the cooperative use of CPUs and GPUs achieves significant improvements on top of GPU-only versions (up to 1.6×) and that the execution of the application as a set of fine-grain operations provides more opportunities for runtime optimizations and attains better performance than coarser-grain, monolithic implementations used in other works. An implementation of the cancer image analysis pipeline using the runtime support was able to process an image dataset consisting of 36,848 4Kx4K-pixel image tiles (about 1.8TB uncompressed) in less than 4 minutes (150 tiles/second) on 100 nodes of a state-of-the-art hybrid cluster system.

(Anon n.d.) The image enhancement mechanism is suggested by the use of suggested technique. The concept of probability density function and normalized distribution is used in this case. The probability density function of the image will become similar to the probability distribution function of the normal image and hence the noise will be introduced within the image. By the use of mean filter the noise is going to be handled [2].

(Mese & Vaidyanathan 2001) The image can be distorted by the use of pixel blurriness. The blur image can be due to the pixel intensity value. The intensity value can lie between 0 and 255. If the image is distorted then the intensity value can be either 0 or 255. This will cause noise within the image. The noise will be handled by the use histogram equivalence technique [8].

(Pilevar et al. 2013)The salt and pepper noise is handled in this paper. In order to handle the noise median filter is being

used. The median filter will be used in order to obtain the median of the three neighboring pixels which are not being corrupted. The salt and pepper noise will cause the spikes within the image. By the use of suggested technique the salt and pepper noise from the image will be removed [9].

COMPARISON OF NOISE HANDLING TECHNIQUES

From the literature surveys comparison of parameters are derived. Comparison table is given as under

Author	Title	Technique	Feature	Remarks
(Pilevar et al. 2013)	A new filter to remove salt and pepper noise in color images.	A new fast and efficient decision based algorithm for removal of high-density impulse noises	The algorithm which is suggested remove the noise from the image	The limitation of the paper is that technique is expensive in nature
(Zhang et al. 2015)	Salt and pepper noise removal in surveillance video based on low-rank matrix recovery	Nonlinear vector filtering for impulsive noise removal from color images	The algorithm which is suggested involve the complex technique for removing impulse noise from the image	The Suggested technique is Complex in nature and take more space in memory
(Teodoro et al. 2013)	High-throughput Analysis of Large Microscopy Image Datasets on CPU-GPU Cluster Platforms	High Density Impulse noise Removal in Color Images Using Median Controlled Adaptive Recursive Weighted Median Filter	The algorithm which is suggested is meant for colored images.	The suggested paper is meant for colored images.
(Mese, M. & Vaidyanathan)	Optimal histogram modification with MSE metric	Image segmentation by histogram thresholding using fuzzy sets. IEEE transaction on image processing	The histogram will be used in order to smoothened the image	The suggested technique can be implemented on the special portion on the image
(Ma, Y. et al., 2007)	A Novel Algorithm of Image Gaussian Noise Filtering based on PCNN Time Matrix.	A Study Effect of Gaussian Noise on PSNR Value for Digital Images	This paper is used in order to determine the Gaussian noise which will introduce corruption within the image	This technique cannot be used for removing extra noise present within the images
P.S.J.sree, P.Kumar, R. Siddavatam and R. Verma	Salt-and-pepper noise removal by adaptive median-based lifting filter using second-generation wavelets	Adaptive median filter	PSNR is enhanced and MSE is reduced	Entropy indicating degree of relationship between pixel is not optimised
K.M.S Raju, M.S Nasir and T.M. Devi	Filtering Techniques to reduce Speckle Noise and Image Quality Enhancement methods on Satellite Images	Filtering mechanism for speckle noise handling	PSNR is increased and Root mean square error is decreased	Contrast enhancement that leads to entropy enhancement is missing

3. CONCLUSION

Noise inside the picture can degrade the picture. Distortion can degenerate the data represented through the computerized media. Source noise could be numerous like picture procurement mechanism, transmission systems and so forth. Noise handling system has been contrived that handles the issue of noise. Generally utilized component incorporates filtering. Adaptive median filtering can be utilized to handle any sort of noise. Size of the picture representation isn't balanced utilizing this strategy. So as to handle this issue repetition dealing with component can be fused inside the middle channel to accomplish advancement as far as PSNR, MSE and entropy.

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