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Research Article

Optimization of Memory Management in Image Processing using Pipelining Technique

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Abstract: The quality of the image is mainly based on the various phenomena which generally consume lots of memory that needs to be resolved addressed. The handling of the memory is mainly affected due to disorderly arranged pixels in an image. This may lead to salt and pepper noise which will affect the quality of the image. The aim of this study is to remove the salt and pepper noise which is most crucial in image processing fields. In this study, we proposed a technique which combines adaptive mean filtering technique and wavelet transform technique based on pipeline processing to remove intensity spikes from the image and then both Otsu's and Clahe algorithms are used to enhance the image. The implemented framework produces good results and proves against salt and pepper noise using PSNR algorithm.

Keywords: Adaptive filter, image processing, pipeline, wavelet transform

INTRODUCTION

An image which is a collection of pixels is processed in two different aspects. Either, the visual appearance of an image has been improved by human view or the measurement of features and structures. (Bovik, 2005) discussed many different techniques that are useful for researchers who are keen to optimize digital images. The book also discussed many basic information for practitioners. (Gonzalez and Woods, 2008) also dealt different and interesting digital image enhancing methods. Today the field of image processing has mainly affected by noise which will degrade the quality of an image. A variation and drastic change in the color and brightness of the image are commonly referred as the noise. A noise in image processing is defined as the unauthentic and unwanted additional information that adds to the product of the image. Noise is also occurring due to the disorder arrangement of the pixels in the image. Due to this disorder arrangement, the memory location is altered by consuming more memory for the execution of the image and the time taken to execute the image is also high. Also the impulse noise known as salt and pepper noise is occurring in the image. To solve this problem, a nonlinear filter known as median filtering technique is used such noise. This technique takes more time to find the median value and also to apply the values in image enhancement technique. A commonly used technique in image enhancement is histogram equalization. This median filtering and histogram equalization is having some general defects. So in our proposed system an Adaptive Filtering (AF) and wavelet transform are both used parallel to remove salt and pepper noise. To enhance the image Contrast level additive histogram equalization (Clahe) and Otsu method are used. These will increase the quality and they are hidden in the process. The implemented procedure reduced noise gradually and proves to be more efficient than the previous methods. The framework also tested and validated by using PSNR algorithm which produces appropriate results.

LITERATURE REVIEW

Today with the introduction of mobile camera feature has created a huge attraction in the market. However, this feature needs a special demand in its architecture. (SMIA 1.0: Introduction and Overview, 2004) depicts an open standard, imaging architecture which is suitable for all vendors. (Nikkanen *et al*., 2008) presented an idea quantify the subjective effects of white-balancing errors in digital camera image. This achieved by using subjective tests. While taking pictures, the color images are affected by noise. Removing noise is one of the most fundamental operations of image processing (Kao and Chen, 2005). Noise Filtering reduces the Sharpness of the image. An integrated approach combines bilateral noise filter, edge detection and edge enhancement was implemented to address these issues. The approach considers different

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characteristics of noise by applying different algorithms to accommodate for the respective properties. The design concepts come from the fact that the images are usually corrupted by many noise sources. Digital imaging is in Rapid growth, so the image should need the low cost sensor. (Bellas and Yanof, 2006) a novel algorithm and hardware implementation of color processing chain to compensate for the quality of lower cost optics has been proposed. It describes how the algorithm mapped for a high speed and low power hardware implementation. The correction stage helps to produce a good quality of the image. A desirable property of digital imaging is to render real world scenes as close to the human being practices (Zhang and Lucchese, 2004). For this kind of situation High Dynamic Range (HDR) is a very challenging issue. Available algorithm of auto white balance relies on heuristic ideas and does not work fine in typical scenes. (Kao *et al*., 2006) Proposes a new image processing pipeline, which processes the raw data of an image captured from CCD sensors and converts it into required color. The quanity of captured images using a mobile device can be enhanced using different image processing algorithm. In order to further optimize the image, Image reconstruction through the pipeline is a very effective technique, for example, line buffer based digital image reconstruction pipeline (Maatta *et al*., 2011). The authors (Zhang and Karim, 2002) discussed a switching median filter with boundary discriminate noise detection method for extremely corrupted images. They have predefined threshold value which is based on the decision is used in a switching median filter. It suffers from defining a robust decision at the same time the edges and details are not improved properly. A switch median filter based on discriminative noise detection technique was proposed (Ng and Ma, 2006) for denoising brutally corrupted images. Their idea was checking whether each pixel of an image belongs uncorrupted or not. However, the authors have achieved only substantial improvement over existing medium-based filter technique.(Jayaraj and Ebenezer, 2010) developed a new switching-based median filtering mechanism for removing high-density salt and pepper noise in the image. The authors said produced better image quality using PSNR, reduced MSE, good edge preservation and reduced streaking. However, it suffers from computational complexity issue. In order to avoid this issue, the authors of Aiswarya *et al*. (2010) have applied unsymmetrical Trimmed Median Filter. Another approach can be used in which a special type of Non Local Means Algorithm is described in which image contained repeated structures (Buades *et al*., 2005). In Luo (2006) Multi State Median (MSM) filter which is based on median switching scheme is presented in a generalized framework. A different center weights are accompanying at the output of the MSM filter due to the use of simple thresholding logic. (Sreenivasan and Ebenezer, 2007) a Noise Adaptive Soft Switching Median (NASM) that contains fuzzy-set concept is used to get better performance during the removal of impulse noise. An alpha trimmed mean a special case of order statistics filter is also employed for the removal of impulse noise (Duan *et al*., 2010). Srinivas and Kalyani (2011) discussed three different methods based on a logarithmic transform histogram to enhance the quality of an image. The authors claimed that the proposed idea outperform existing techniques.

METHODOLOGY

The operations of different components of the proposed architecture are discussed below:

Adaptive filtering: An adaptive filter that attempts to model the relationship in a real time environment between two signals in an iterative manner.
The four ways to define the adaptive filter:

- The filter that processing the signals.
- The input signal which is computed to get the output signal defines the structure of the signal.
- The input-output relationship of the parameters for the filter can be iteratively changed.
- One time instant to the next parameter Adjustment is described by the adaptive algorithm.

The adaptive filter is more selective than a comparable either a linear filter or reserving edges. Furthermore, there are no suitable design tasks; the wiener 2 function handles all preliminary computations and implements the filter to an input image. One of the limitations of the Wiener 2 function is, taking more computation time than linear filtering. In the proposed approach to overcome the above said problem by not considering the affected pixels during the calculation of the mean and the unaffected pixels are not changed. The behavior of adaptive filter changes based on statistical characteristic of the image inside the filter region defined by the mxn rectangular window adaptive filter as the size of the rectangular window.

OTSU'S method: The Otsu's method is done to cluster threshold images and to reduce the gray level image to binary. It assumes the image threshold class has two pixels so that optimum threshold between the classes in the combined spread should be minimum.

This extension is referred to as multi Ostu methods. By this method we will search for the threshold that optimizes the difference between them, which is stated as a weighted sum of two classes.

CLAHE algorithm: CLAHE algorithm has proven to be a most successful algorithm to increase of low contrast images. It will separate the images into determining region and histogram will be applied. This process will even out the gray values and make the hidden image to become more visible.

Algorithm CLAHE:
//**Input:** Image, Number of segments, bins and clip limit.
//**Output:** Enhanced Image

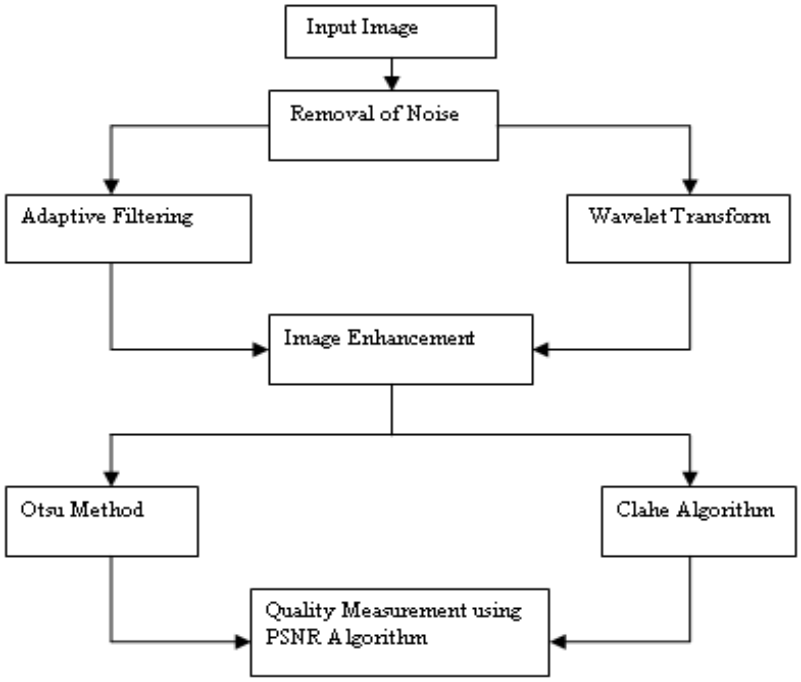


Fig. 1: Architecture diagram of function

Get Image, number of segments, bins and clip limit
Normalize the clip limit value
Segment the image
For each segment (1 to n)
{
Construct histogram for segment i
Clip the histogram
Create mapping for segment i
}
For each cluster of neighboring mapping function
{
Extract a single pixel
Apply mappings
Output pixel←interpolate between the Results
}

In this algorithm sharp field edges can be obtained by selective enhancement within the boundaries. Noise can be reduced by maintaining high frequency at the content of the image by applying a median filter and edge sharpening. This is referred as sequential processing. AHC clip known as adaptive histogram clip it will adjust the clip level and will increase background region of portal images.

Wavelet transform: In the area of applied mathematics, Wavelet analysis is a new expansion. Wavelets are mathematical functions that permit complex information to be decomposed into different frequency segments and then analyze each segment with a boldness matched to its scale. A complement to the classical Fourier transform is wavelet transform function. The studying of data with transient events is not ideal for the Fourier analysis, but it suits for studying the stationary data. Wavelet transforms are particularly useful for aperiodic, noisy, non-continuous and transient type of signals (Sreenivasan and Ebenezer, 2007). Wavelet transform will have special skill to scrutinize signals simultaneously in both time and frequency. Wavelet indicates small waves by taking different shape called a mother wavelet. A wavelet can be built, dilating and compressing or shifting in particular time. They are classified as Continuous Wavelet Transforms (CWTs) and Discrete Wavelet Transforms (DWTs). Wavelets with their generality and strong results have well suited to solve a number of real world applications. One of the current applications of wavelet take account of climate analysis, seismic signal de-noising, compression, heart monitoring and so on (Fig. 1).

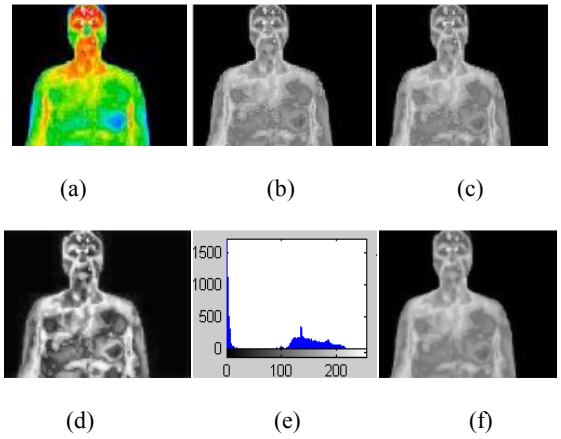
PSNR algorithm: The performance parameters are most essential criteria to rationalize results through evaluation. The parameters considered a Peak Signal to Noise Ratio (PSNR).

It will measure the signal noise ratio between two ranges in decibels. It will measure the quality between the compressed and original image. If the PSNR is high, then image quality is high. Two processes are effectively used to compare image compression. They are Mean Square Error and Peak Signal to noise ratio. Lower the value of MSE than error value will be low.

RESULTS AND DISCUSSION

The proposed framework is implemented in Matlab in which different noise level from different images have been taken for verification process. An example image Fig. 2a is taken for analysis and the next Fig. 2b shows the adding of noise and how the noises are removed using adaptive filters (Fig. 2c to f).

The proposed algorithm tested for 256×256 images. It is tested for various levels of noise values and also compared with Median Filter (MF) (Fig. 3). Figure 4 and 5 shows the de-noising performance of the proposed algorithm. Table 1 shows the PSNR values of the proposed method and also based on the MF method with different noise variance. Figure 6 shows the comparison of PSNR value for median filter and our proposed method.



(a) (b) (c)

(d) (e) (f)

Fig. 2: (a): Original image; (b): Gray scale image; (c): Adaptive filter; (d): Enhanced image; (e): Image histogram; (f): Resize image

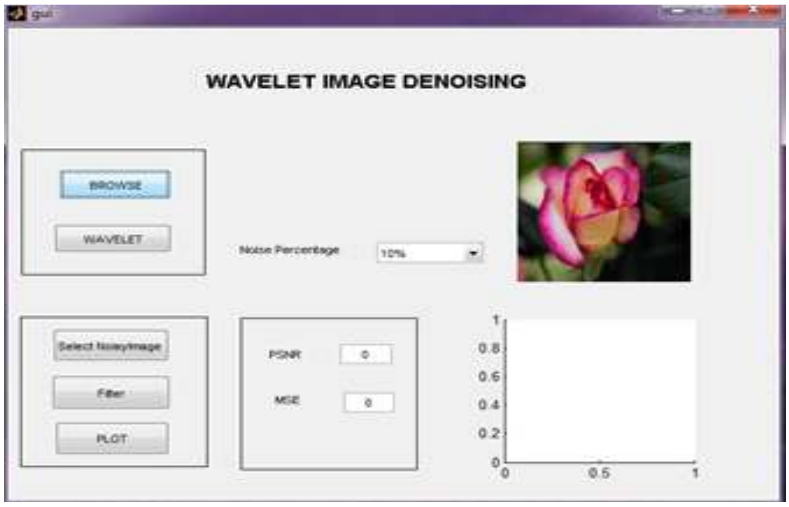


Fig. 3: Selection of image with noise percentage

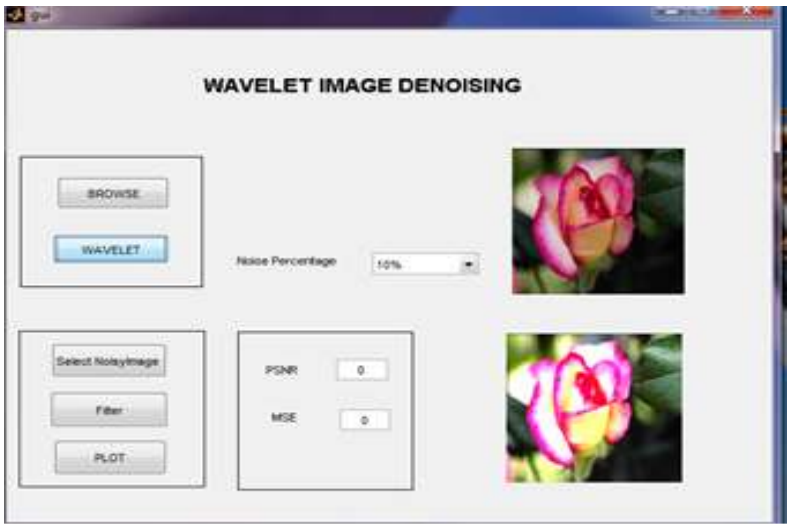


Fig. 4: Wavelet image denoising

(a) (b)

Fig. 5: (a) Original image (b) Wavelet denoised image

Table 1: Comparison of PSNR values at different noise densities

Noise level	Median filter	Proposed method
10	33.13	44.88
20	32.43	41.24
30	28.79	38.82
40	25.16	37.19
50	22.65	35.69
60	18.08	34.15
70	16.26	32.89

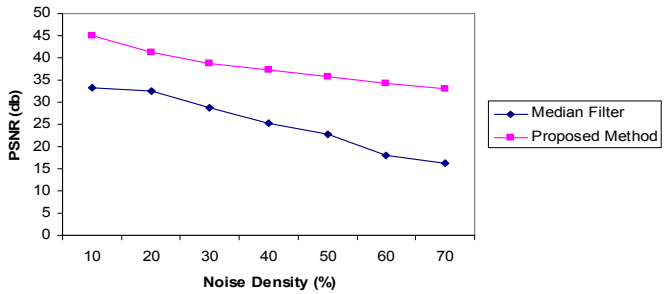


Fig. 6: Comparison graph of PSNR at different noise densities

CONCLUSION

Removal of noise in an image is a most challenging task in the image processing field. In our paper, adaptive filter and wavelet transform is used to optimize images using piplelining technique. The quality enhancement of the image is improved significantly using clahe and Otsu method. By the PSNR algorithm the quality of the image is verified and measured. The simulation experimental results prove that the quality of the image is improved significantly compare to existing approaches by reducing the noise.

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