A New Hybrid Approach to Remove Salt and Pepper Noise from Colorscale Images

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Abstract

In this paper, a new hybrid approach to remove salt and pepper noise from colorscale images is given. This is DBWMF. DBWMF is basically a combination of Decision Based Median Filter and Weighted Median Filter. It is a nonlinear digital filtering technique, which is used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing .Median filtering in our research we will focus on recovery of images by denoising through two very advanced methods i.e. weighted median filter and decision based median filter. This technique would also involve edge retaining technique. The prime focus will to bring about noise removal in the images having amount of noise which can't be removed by simple denoising techniques. We will use combination of these two techniques. We will then calculate various performance parameters such as PSNR, MSE, Euclidean distance of input and output images.

Keywords— *image noise, denoising, filters, image enhancement, image processing, median filter*

1. Introduction

An image is an array or a matrix of square pixels arranged in columns and rows.
Depending on colors images are of two types:

- Grayscale image
- Color image

Depending on the dimensions images are also two types

- Two dimensional image
- Three dimensional image

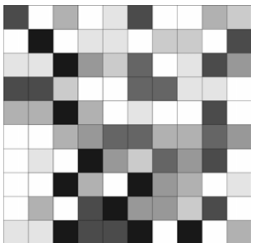

Figure1.1 Grayscale Image

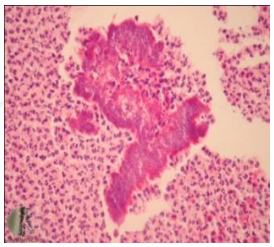

Figure 1.2 Color Image

Digital images play an important role both in daily life applications such as satellite television, medical field as well as in the areas of research and technology. Like other digital signal, digital images are also sometime could be corrupted by noise. Noise is an undesirable product of image. When we are using medical image e.g. liver, brain then these images should be totally noise free. Any type of noise if present in the image then it will create problem to the doctors to understand the image. So removing noise from degraded images is a challenging research field in image processing. It involves estimation procedure of the image corrupted by noise. The main objective of image enhancement is to process the image so that the result is more suitable than the original image [2]. Salt & pepper noise is such type of noise which represents itself as randomly occurring white and black pixels. An image containing this type of noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise is removed by a median filter which is the

most popular nonlinear filter. Thus, denoising is often a necessary and the first step to be taken before the images data is analyzed.

2. IMAGE NOISE AND ITS TYPES

Noise is that which degrades the quality of an image. It is unwanted information and random variation of brightness or color information in images. It reduces the image detail and clarity. Noise is most noticeable in even areas of color such as shadows.
Different types of noises

- **Salt-and-pepper noise**

In this type of noise an image will have dark pixels in bright regions and bright pixels in dark regions. Salt and pepper noise is an impulse type of noise, which is called spikes. It has two possible values, a and b. The probability of each is typically less than 0.1. The corrupted pixels are set alternatively to the minimum or to the maximum value, giving the image a "salt and pepper" like appearance. The pixels which are not affected remain unchanged. Value for pepper noise is 0 and for salt noise 255, for an 8-bit image.

- **Shot noise**

The dominant noise in the lighter parts of an image from an image sensor is typically that caused by statistical quantum fluctuations, that is, variation in the number of photons sensed at a given exposure level; this noise is known as photon shot noise. Shot noise has a root-mean-square value proportional to the square root of the image intensity, and the noises at different pixels are independent of one another. In addition to photon shot noise, there can be additional shot noise from the dark leakage current in the image sensor; this noise is sometimes known as "dark shot noise" or "dark-current shot noise". Dark current is greatest at "hot pixels" within the image sensor; the variable dark charge of normal and hot pixels can be subtracted off, leaving only the shot noise, or random component, of the leakage; if dark-frame subtraction is not done, or if the exposure time is long enough that the hot pixel charge exceeds the linear charge capacity, the noise will be more than just shot noise, and hot pixels appear as salt-and-pepper noise.

- **Speckle Noise**

This is a multiplicative noise. Speckle noise occurs in almost all coherent imaging systems such as laser, acoustics and SAR (Synthetic Aperture Radar) imagery. Attributed to random interference between the coherent returns is the source of this noise.

- **Poison Noise**

This noise is induced by the nonlinear response of the image recorders and detectors. This type of noise is image data dependent. This term arises because detection and recording processes involve random electron emission having a Poisson distribution with a mean response value. Since the mean and variance of a Poisson distribution are equal, the image dependent term has a standard deviation if it is assumed that the noise has a unity variance.

3. DIFFERENT TYPES OF MEDIAN FILTERS

Filtering in image processing is a process that cleans up appearances and allows for selective highlighting of specific information. There are thousands median based filters available in literature. For example, the search "median filter" from Google and IEEExplore database returns thousands of results. Some median filters are explained as:

- **Median filter**

In median filter central pixel value is replace by the median value of its neighboring pixels comes within the window. The original value of the pixel is included in the computation of the median. This provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size [3][4].

- **Min-Max Median Filter**

Min-Max filter (MMF) [4] is conditional non linear filter. In this filter (3x3) window is use for scanning the image left to right and top to bottom. The center pixel of window (2, 2) is considered as a test pixel. If test pixel is less than minimum value present in rest of pixel in window and greater than maximum value present in rest of pixel in window. Then center pixel is treated as corrupted pixel and its value is replaced by median value of pixels present in window otherwise pixel is non corrupted pixel kept pixel value unchanged.

- **Adaptive Median Filtering**

The Adaptive Median Filter performs spatial processing to determine which pixels in an image

have been affected by noise. It classifies pixels as noise by comparing each pixel in the image to its surrounding neighbor pixels. Neighborhood pixel size is adjustable and the threshold for the comparison. A pixel that is different from a majority of its neighbors, and being not structurally aligned with those pixels to which it is similar, is known as impulse noise. These noisy pixels are then replaced by the median value of the pixels in the neighborhood that have passed the noise detection test.

- **Weighted Median Filter**

The weighted median (WM) filter is a natural extension of the median filter and has the same advantages as the median filter: edge preservation and efficient suppression of impulsive noise. Having a set of weights, however, the WM filter is much more flexible in preserving desired signal structures than a median filter. This is explained as follows. A window width 2K+ 1 median filter can only preserve details lasting more than K+ 1 points. To preserve smaller details in signals, a smaller window width median filter must be used. Unfortunately, the smaller the filter window is, the poorer its noise reduction capability

[6][9].

- **Center Weighted Median Filter:**

The Center weighted median (CWM) filter [7] is an extension of the weighted median filter, which gives more weight to center values within the window. These approaches involve a preliminary identification of corrupted pixels in an effort to prevent alteration of true pixel values.

- **Decision Based median filter:**

Decision-based median filter [8] firstly detects possible corrupted pixels in an image, and then replaces them with the median value of their k-nearest pixels, while still leaving noise-free pixels unchanged. Several recent studies have shown that decision-based median filter performs well for images corrupted by low-level noise. However, the performance of decision-based median filter significantly degrades if more noise is added. This is because pixels locating in the neighborhood of a corrupted pixel may also be noise when images are corrupted by high-level noise. In this case, it is unreasonable to simply replace a corrupted pixel with the median value of their k-nearest pixels.

Drawbacks in median filter

- Existing median filters uses fixed or different window size for detection of impulse noise. There is no algorithm is exist which can automatically calculate the required window size.
- Existing median filters not provides consistent output in both low and high noise conditions.
- Existing median filters are not good for real time applications because of their time consuming nature.

4. Proposed work

Decision Based Weighted Median Filter
This is a hybrid form of decision base median filter and weighted median filter. DBWMF is basically a combination of Decision Based Median Filter and Weighted Median Filter. In this filter, first Decision Based Median Filter is apply on the input RGB image then output of this filter is apply to the weighted median filter. This technique is more effective in eliminating salt and pepper noise and preserving the image features.

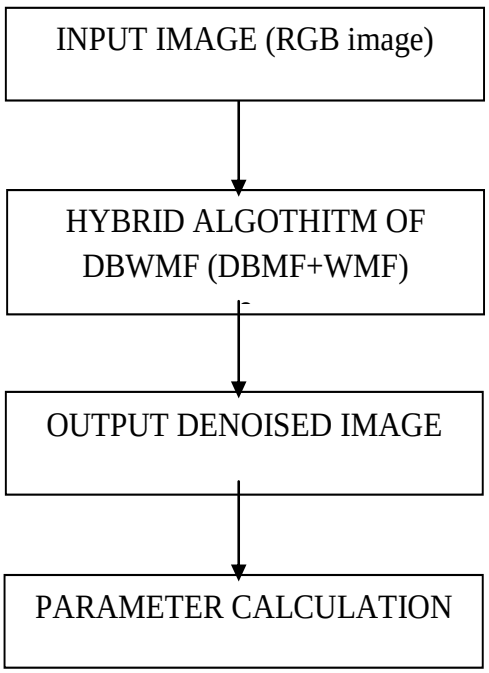

Figure 4.1 Flow chart of image enhancement with decision based weighted median filter

5.SIMULATION AND PERFORMANCE ANALYSIS

This method has been implemented using Matlab as the simulation tool. In this, the image is corrupted by Salt and Pepper noise and performance is measured using the parameters such as Peak-Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE), correlation and elapsed time.

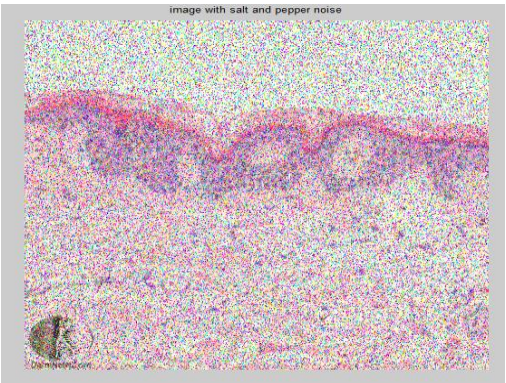

Figure 5.1 Noised image

Figure 5.2 Denoised image

Table 5.1 Different values of color Images with noise and without noise

IMAGE	PSNR(in db)	MSE	CORRELATION	ELAPSED TIME in seconds
NOISED	9.0037	90.7933	0.9929	4.263694
DENOISED	34.9849	4.5603		

Above table shows that when we apply decision based weighted median filter on noised image then the output of the filter gives better result

6. CONCLUSION

The purpose of this paper is to present a new median filter to denoise images. This is new filter DBWMF for removal of salt and pepper noise from colored images. The proposed scheme can be helpful in area like medical field where the degree of noise free image is important. This filter is useful for noise removal in the images having amount of noise which can't be removed by simple denoising techniques. Results shows that PSNR value is high of the denoised image as compare to noised image and MSE is low of the denoised image as compare to noised image.

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