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A Novel Approach to Identify the Presence of Noise in Under Water Sea Images

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Abstract
This study applies a technique to find the noise presence in the given color image. Here the underwater sea images are taken for study. The presence of noise on the image is analyzed with the distribution of intensity values of all components of image spread. The image is polluted by different types of noises like salt & pepper , speckle, Gaussian and Poisson noise. This paper indentifies the occurrence of noises in these images and removes it. Hence the proposed algorithm is organized in three steps. In the first step, the suitable color model is chosen to identify the presence of noises in the given color image. In the second step, the occurrence of noises in the images is identified. In the third step, identified noises are removed by analyzing intensity distribution of affected image and applying Point Spread Function (PSF) . The performance of this algorithm is analyzed using occurrences of last intensity level set.

Keywords
(Salt & Pepper, Gaussian, Speckle, Poisson, Underwater Sea Images, PSF, Color Model)

I. Introduction
Digital image processing , with the help of computer the digital image is procesed to gvie a meaningful information for human interpretation.

A. Digital Image
An Image can be defined as a two dimensional function, f(x, y), where x and y are spatial coordinates, and the amplitude of f at any pair of coordinates (x, y) is called intensity or gray level of the image at that point. When x, y and the amplitude values of f are all finite, discrete quantities .The process of digital image is categorized into three levels. They are low, mid and high level process. Low level process involves primitive operations, such as image preprocessing to reduce the noise, contrast enhancement and image sharpening [1]. The removal of noise should be done in preprocessing level. Because noise is an error in an image. So the error should be removed from the image before further enhancement process. Here the color image is taken to identify the noise presence and restore the given image.

II. Review of Literature
In this paper Noise estimation is an important process in digital imaging systems. Many noise reduction algorithms require their parameters to be adjusted based on the noise level. Filter-based approaches of image noise estimation usually were more efficient but had difficulty on separating noise from images. Block-based approaches could provide more accurate results but usually required higher computation complexity. In this work, a design framework for combining the strengths of filter-based and block-based approaches is presented. Different homogeneity analyzers for identifying the homogeneous blocks are discussed and their performances are compared. Then, two well-known filters, the bilateral and the non-local mean, are reviewed and their parameter settings are investigated. A new bilateral filter with edge enhancement is proposed. A modified non-local mean filter with much less complexity is also present. Compared to the original non-local mean filter, the complexity is dramatically reduced by 75% and yet the image quality is maintained.[4]
This paper proposes an improved method for suppressing impulsive noise of random values from contaminated images. Filtering is carried out only on noisy pixels keeping the noise-free ones intact. To decide whether a pixel is corrupted or not, the proposed scheme employs an artificial neural network with parameters of the noisy image as input. Filtering is performed recursively so that the restored noisy pixels of the current window participate in the detection phase of the next window. Exhaustive simulations indicate that the proposed scheme consistently outperforms its counterparts in suppressing impulsive noise and retaining original image properties.[5]
In this paper, the study is done with the problem of restoring the image corrupted by additive Gaussian noise plus random-valued impulse noise. A novel noise classifier is firstly created to identify different noise in the corrupted image. Then, we use the remaining effective information to train an adaptive over complete dictionary for sparse representation of image patches with the help of masked K-SVD algorithm. Because of the adaptive nature of the learned dictionary, it can represent the image patches in more efficiently. Then, minimized a variational model containing an optional data-fidelity term and a smooth regularization term respecting sparse representation of every image patch to get the final restored image. Extensive experimental results proved that this method cannot only remove noise from the corrupted image well, but also preserve more details and textures. It surpasses some state-of-the-art methods.[6]
Image deblurring is one of the fundamental problems in the image processing and computer vision fields. In this paper, new approach is designed for restoring images corrupted by blur and impulse noise. The existing methods used to address this problem are based on minimizing the objective functional, which is the sum of the L_1-data fidelity term, and the total variation (TV) regularization term. However, TV introduces staircase effects. Thus, new objective functional is proposed that combines the tight framelet and TV to restore images corrupted by blur and impulsive noise while mitigating staircase effects. The minimization of the new objective functional presents a computational challenge. A fast minimization algorithm is proposed by employing the augmented Lagrangian technique. The experiments on a set of image deblurring benchmark problems show that the proposed method outperforms previous state-of-the-art methods for image restoration.[7]

In this paper a method is proposed for reduction of speckle effect by recording a hologram and then dividing it to several sub-holograms. Each sub-hologram is used to produce an image. Final image is constructed by superposition of these images. The final image has a smaller amount of speckle noise. Experimental results verify effectiveness of this technique.[8]

In this paper, the restoration of images corrupted by Gaussian plus impulse noise is studied , and propose al_1–l_0 minimization approach where the l_1 term is used for impulse denoising and the l_0 term is used for a sparse representation over certain unknown dictionary of images patches. The main algorithm contains three phases. The first phase is to identify the outlier candidates which are likely to be corrupted by impulse noise. The second phase is to recover the image via dictionary learning on the free-outlier pixels. Finally, an alternating minimization algorithm is employed to solve the proposed minimization energy function, leading to an enhanced restoration based on the recovered image in the second phase. Experimental results are reported to compare the existing methods and demonstrate that the proposed method is better than the other methods.[9].

In paper [4] the noise is estimated using block based approaches and in paper [5] the noise is analyzed with an artificial neural network with parameters of the noisy image as input. The authors of paper [6] have developed a novel noise classifier to identify different noise in the corrupted image by using the effective information to train an adaptive over complete dictionary for sparse representation of image patches with the help of masked K-SVD algorithm. Here we proposed an algorithm for noise indication by analyzing the probability of intensity values distribution of all color components of an image.

III. Theoretical Aspects

A. Noise

It can be defined that the noise to be any degradation in the image signal, caused by external disturbance. If an image is being sent electronically from one place to another, via satellite or wireless transmission, or through networked cable. It might be expected errors to occur in the image signal. These errors will appear on the image output in different ways depending on the type of disturbance in the signal [2].After identifying the types of noises by which the image was polluted then the effort should be taken to identify the appropriate method to reduce the effects .Image restoration is used to clean the image which is corrupted by noise.

B. Noise Models

1. Salt and Pepper Noise

It is also called as impulse noise, or binary noise. This degradation can be caused by sharp, sudden disturbances in the image signal, its appearance is randomly scattered white or black (or both) pixels over the image.

2. Gaussian Noise

Gaussian noise is an idealized form of white noise, which is caused by random fluctuations in the signal. It can be observed white noise by watching a television which is slightly mistuned to a particular channel. Gaussian noise is white noise which is normally distributed. If the image is represented as I and Gaussian Noise by N and a noisy image can be modeled by simply adding the two :(I + N).

3. Speckle Noise

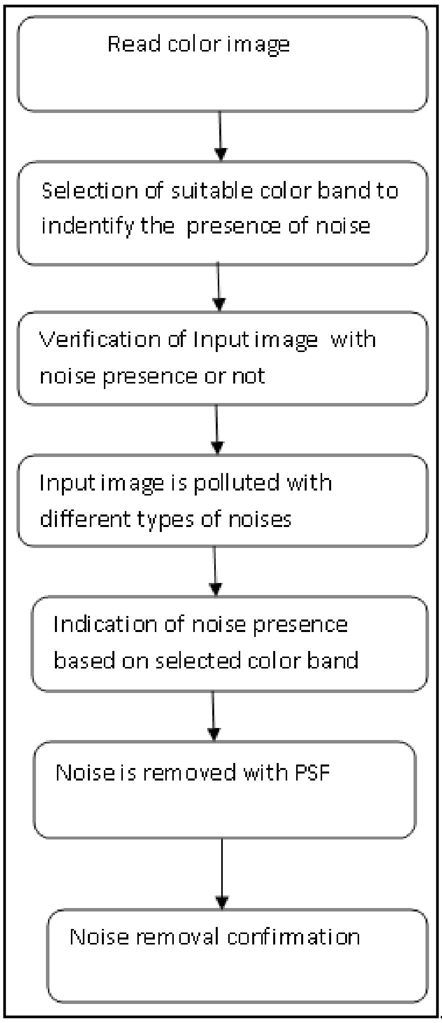
Gaussian noise can be modeled by random values added to an image , where as Speckle noise (or more simply just speckle) can be modeled by random values multiplied by pixel values, hence it is also called multiplicative noise. Speckle noise is a major problem in some radar applications. Speckle noise is implemented as where it is the image matrix, and it consists of normally distributed values with mean 0[2]

4. Poisson noise

It generates Poisson noise from the data instead of adding artificial noise to the data. In order to comply with Poisson statistics the intensities of uint8 and uint16 images must correspond to the number of photons. Double precision images are used when the number of photons per pixel is larger than 65535.[1]

IV. Methodology

I have taken three underwater sea images , they are fish1.jpg, fish2.jpg and fish3.jpg downloaded from internet. All images are in three bands. So process is applied in each component of given jpeg image.In this work RGB color space is considered. The objective of this study is to check whether the given image is affected by noise or not.



The identification is done here, by checking the propabilty of high intensity level -255 presence of in each color component of color image. Here the dominant color component is identified by finding the number of occurance of intensity value 255 of red,green and blue components of the given input image. [red(255)=1, Green(255)=5, Blue(255) is 2.] It indicated in Table 1. Here for

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fish1.jpf the maximam count of intensity level of 255 is in green component. For fish3.jpg and fish2.jpg the dominent one is Blue component. That`s why the green component histogram of fish1.jpg image and the blue component histogram of fish2.jpg,fish3.jpg images is taken for polution checking . The selection is indicated with Red colored numeric in given Table 1. In this study the sample noise models are Speckle , salt & Pepper and Gaussian and poisson. First the image is poluted by appling all these noise models .The occurance of High level intensity value is high in all poluted images.That is indicated in Histogram (blue line at 255), If it is presence then we can say the given image is affected by noise.For the input image fish1.jpg there is no blue line at intensity level 255 of green component (Dominent band) .It is shown in figue-1.The noise is removed with point spread function of Disk filters for all the four given noise models.The results are shown in Fig.3.

V. Experimented Results

The image given in Fig.1. is fish1.jpg. The size is =259*194*3 and the class is uint8.

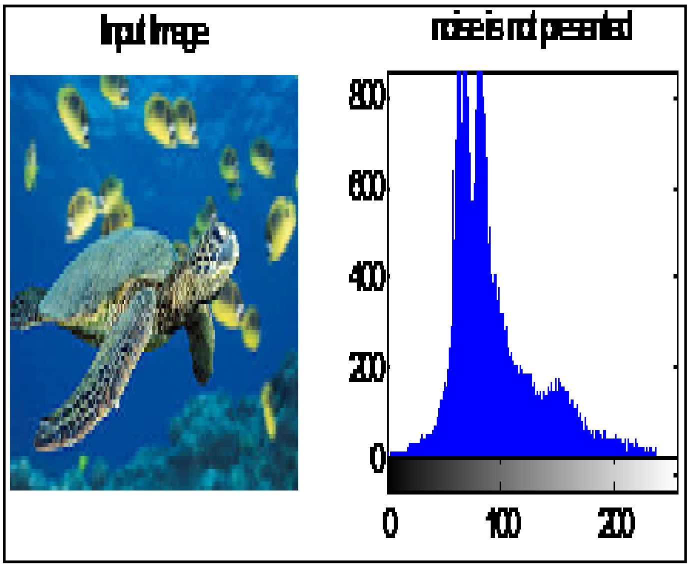

Fig. 1: Input Image with its histogram

Table. 1: Selection of suitable component for noise indication

Input Image	Red Component Occurrences (255)=	Green Component Occurrences (255)=	Blue Component Occurrences (255)=
Fish1.jpg Size=259*194*3	1	5	2
Fish2.jpg Size=300*168*3	171	106	683
Fish3.jpg Size=259*194*3	32	84	3306

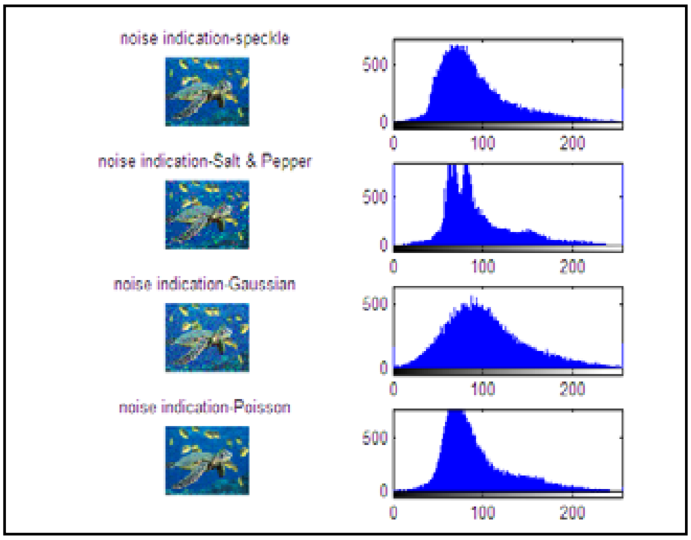

Fig. 2: Noise presence indication

Fig. 3: Restored Image

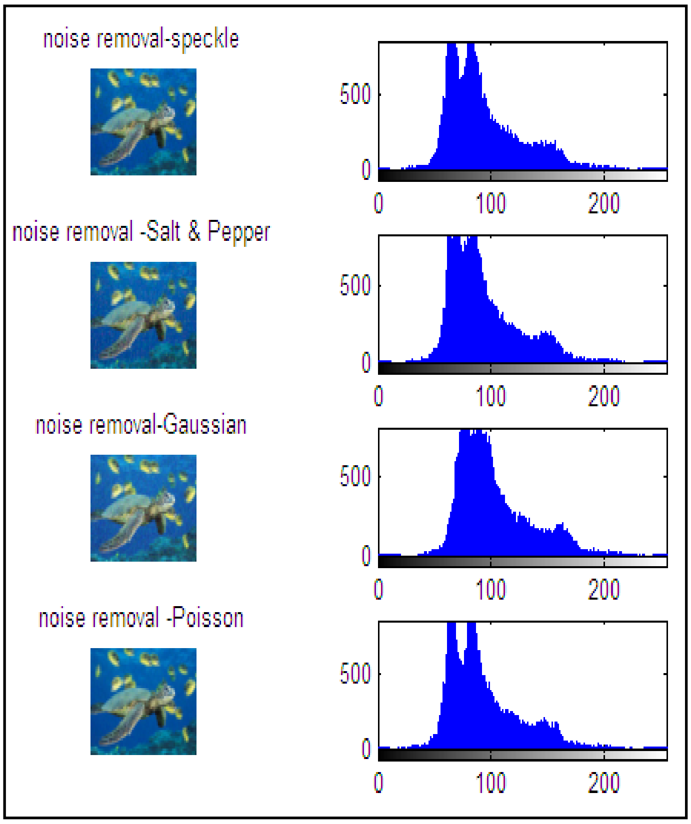

Fig. 4: Indication of noise absence

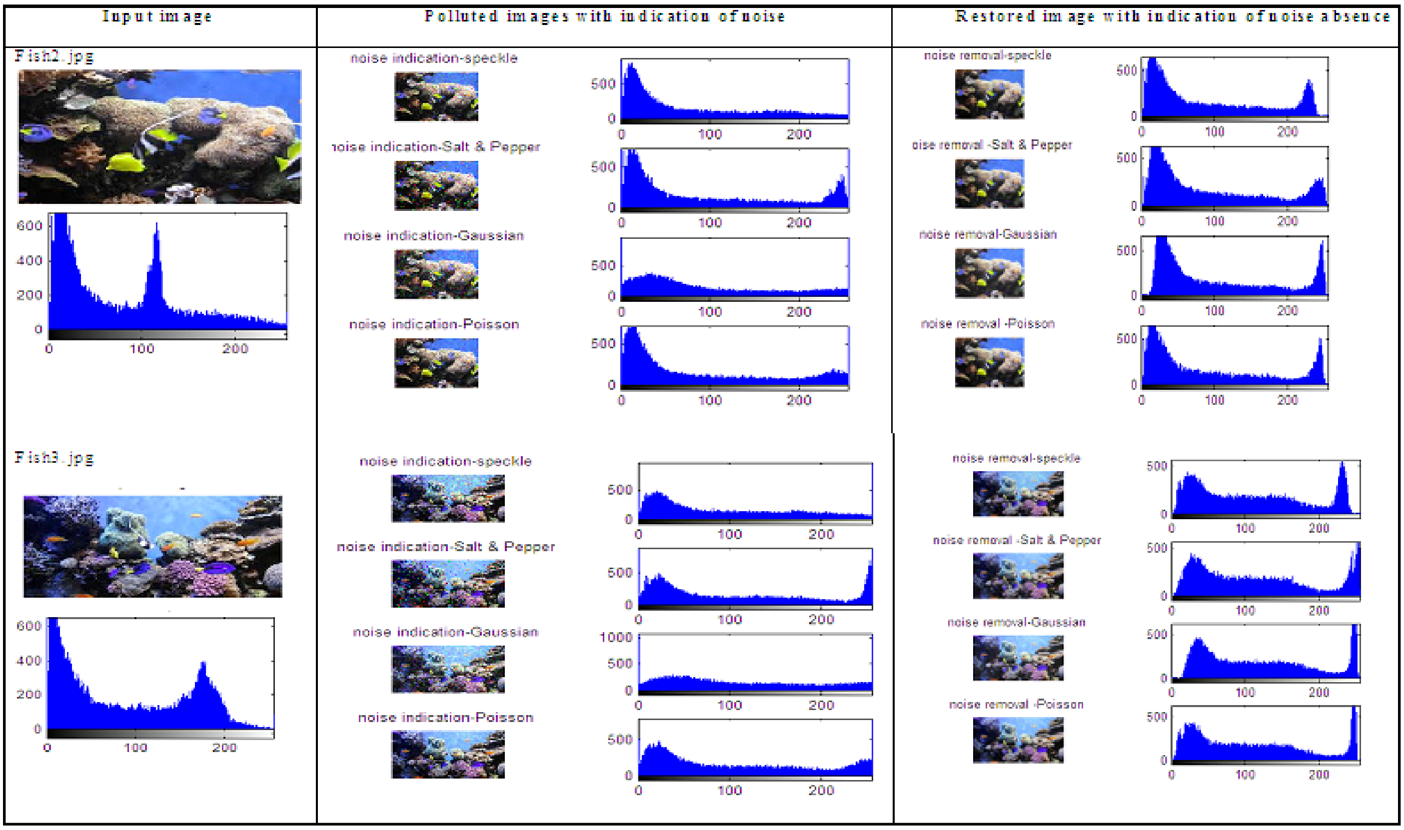

Fig. 5: Results of polluted images with restored images

In Fig .3. The restored image of fish1.jpg is shown along with its polluted images with different types of noises. Fig. 4. Shows the indication of restoration of fish1.jpg . In Fig.5 results of other two images with the indication of noise presence and the indication of noise removal is shown.

Table. 2. Results of all three images with noise removal confirmation

Noise Models	Images	Speckle	Salt & Pepper	Gaussian	Poisson
Number of Occurrences of intensity level 255 of selected color model	INPUT Fish1.jpg	5-Red Band			
	Fish2.jpg	683-Green Band			
	Fish3.jpg	3036-Green Band			
	OUTPUT Fish1.jpg	329	995	220	37
	Fish2.jpg	1018	1109	833	291
	Fish3.jpg	618	1042	503	129
After Removal of Noise With PSF	INPUT Fish1.jpg	Last 20 intensity levels are Zero			
	Fish2.jpg	Last 10 intensity levels are Zero(1 occurred – 1 time,2 occurred – 1 time			
	Fish3.jpg	Last 20 intensity levels are Zero(1 occurred – 3 times,2 occurred – 3 times			
	OUTPUT Fish1.jpg	Last 22 intensity levels are zero	Last 20 intensity levels are zero	Last 9 intensity levels are zero	Last 20 intensity levels are zero
	Fish2.jpg	Last 19 intensity levels are zero	Last 11 intensity levels are zero	Last 6 intensity levels are zero	Last 11 intensity levels are zero
	Fish3.jpg	Last 19 intensity levels are zero	Last 23 intensity levels are zero-2(2 occurred 2 times and I occurred 6 times	Last 14 intensity levels are zero-2(2 occurred 2 times and I occurred 3 times	Last 22 intensity levels are zero-(2 occurred 2 times and I occurred 3 times

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VI. Results and Discussion

In Table.1. it is shown how the proper color model is selected to indicate the addition of noises in a given color image, it is highlighted with red text for all the three images. From the Table.2. It was analyzed that the noise removal is confirmed by having comparison of smoothened input image intensity values probability of green component with each and every restored image of all three images. Among the three images Salt & Pepper and Poisson noises are removed and results go with smoothed input image. It is indicated by brown text for fish1.jpg, violet text for fish2.jpg and orange text for fish3.jpg . Also Speckle noise removal of fish3.jpg goes lies with smoothened input image.

VII. Future Work

This algorithm is working for normal photo images of undersea images. The same kind of work is to be carried out for sonar images of underwater sea objects. Proper noise removal algorithm has to be designed for each and every type of noise. Also new algorithm is going to be designed to subtract the background to highlight only the ROI which enables the detection objects in a given color image.

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