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Denoising of **U**nderwater dehazed images using a **N**ovel **I**mage **E**nhancement **Al**gorithm

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Abstract

Underwater imaging plays an important role in scientific research of Image Processing. However, because the light is absorbed and scattered, the obtained underwater images are severely degraded. Backscattering is increased due to the frequent reflection and deflection of the light by the suspended particles before reaching the camera. The backscattering gives rise to specific strong correlated noise together with a constant level degrading the image contrast. Researchers are involved and developed many effective dehazing methods to remove the veil background. But, they have ignored the influence of backscattering noise, which still exists in the dehazed images. Because of the special characteristics of backscattering noise, the conventional image denoising methods are difficult to make sense, even cause distortion. In this research, proposed component of a novel integrated image enhancement algorithm is used to solve this problem. Filters are used as a preprocessing tool to control noise, preserves edges and corners and to enhance the image. The proposed integrated algorithm employed 2D median filter which is used to suppress the backscattering noise. The simulation result shows that they can effectively remove the backscattering noise of underwater image and display the clarity of image.

Keywords: denoising, Median filtering, underwater image processing, image enhancement

I. Introduction

The visual effect of underwater image is varying from the aerial view. The two main issues which arise in underwater images are light scattering and color degrading. Absorption and scattering are the two basic process of light propagation in the water [1]. The process of the light in the water can influence the overall performance of underwater imaging system. The main role of underwater images plays a decisive role in image processing research such as observing sea life, taking census of populations and assessing geological or biological environments. Due to the presence of haze, capturing the images from underwater is difficult, by light that is reflected from a ground surface is scattered and deflected by water particles and also the attenuation

caused by various wavelengths of light, the captured underwater images always dominated by a bluish tone.

In the past decade, enormous research is undergoing for removal of noise from the captured underwater image as well as to enhance the visual effect of the image. Still scattering of light and color change problems are exist in the underwater image. Scattering problem is arises due to the large suspended particles, its tends to leads the degradation of the image. Color change problem is also arises due to the different wavelengths are attenuated to different degrees in water, causing ambient underwater environments to be dominated by a bluish tone. In this paper, median filter is used to enhance the image by filtering the noise. The objective of the proposed work is to develop a qualitative approach to produce a more visually pleasing image.

This paper is divided into five sections with section I being the Introduction. In section II, we take a look at the existing methods, Section III deals with Proposed Algorithm, and section IV involves Simulation and performance evaluation. Finally in Section V, we conclude the proposed algorithm performance from the simulation result.

II Proposed Work

More than a decade, a enormous research is undergoing for the enhancement to the degraded underwater images. Still there is need for a development in the same. In this proposed algorithm give support to improve the quality of the degraded underwater images. The implementation of denoising algorithm should not change the information of the original images. So the role of noise should be very small while some type of regularity for the image is assumed. If a denoising algorithm play the role well in manner, the filtered image have visually pleasant effect.

The underwater images are mostly affected by haze and various noise, specifically by Gaussian noise, speckle noise and salt and pepper noise. Due to these various degrading factor, it is possible to loose the information or getting unpleasant visual effect. Various researches are undergoing for removal of these noise like salt and pepper noise, speckle noise etc present in the underwater images. In this research, a median filter is proposed to remove the presence of noise. In this method, the dehazed images are given to the preprocessing block and then the noise is removed by our proposed algorithm.

Median Filter

The preprocessing or filter is one of the important building block in many image processing technique. In this research, the median filter is employed for removal of salt and pepper noise [4]. The idea of mean filtering is simply to replace each pixel value in an image with the mean (average) value of its neighbors,

including itself. This has the effect of eliminating pixel values which are unrepresentative of their surroundings. Mean filtering is usually thought of as a convolution filter. Like other convolutions it is based around a kernel, which represents the shape and size of the neighborhood to be sampled when calculating the mean. It is easy to implement for smoothing images due to the simple and intuitive, so it reduce the amount of intensity variation lies between one pixel and the next. It is often used to reduce noise in images especially salt and pepper noise and speckle noise. When the trend toward huge images and proportionally larger filter kernels, the required for a more efficient median filtering algorithm. In this context, a new and simple yet much faster algorithm is discussed and analyzed. The median filter a conventional image processing operation, and best known for salt and pepper noise removal processing. It is also the foundation for which more advanced image filters algorithm like un-sharp masking, rank-order processing, and morphological operations are built. But, it require the long time for processing, it is one of the limitation of this filter. The median is the value situated at the middle of the list. When the number of possible pixel values is a constant, as is the case for 8-bitimages, one can use a bucket sort, which brings the complexity down to O(r2).

IV Result and Discussion

The quality of the image can be analyzed by two methods, called as subjective and objective methods[5]. Subjective method is mostly used for determining perceived quality of an image as it can be said that the human being is the best judge itself. The output of the proposed method has a better quality visually than the original underwater input image. The another method is called as Objectively, there are several parameters through which it can be quantitatively proved which image is better. In this paper, considered parameters like peak signal to noise ratio (PSNR) and mean absolute error (MAE).

A. Mean Absolute Error

Mean Absolute Error (MAE) is a quantity which is used to analyze how much closed to the enhanced image compared with original image. If the lower value of the MAE denotes better the quality of the image. MAE can be determined from the below expression [2]

$$MAE = (\sum_{i=1}^{n} \| y_i - x_i \|) / n = ((\sum_{i=1}^{n} \| e_i \|) / n)$$

the MAE is an average of the absolute errors

$||e_i|| = ||y_i - x_i||$ $||e_i|| = || y_i - x_i ||$, where y_i is the prediction and xi is true value

B. Peak Signal to Noise Ratio

Peak Signal to Noise Ratio (PSNR) is the ratio between the maximum peak of a original image signal and the power of image corrupted by noise. If the value of PSNR is increased, it means that the quality of the image is increased. PSNR is given in decibels. PSNR can be obtained from

Fig 1(a) Original color image

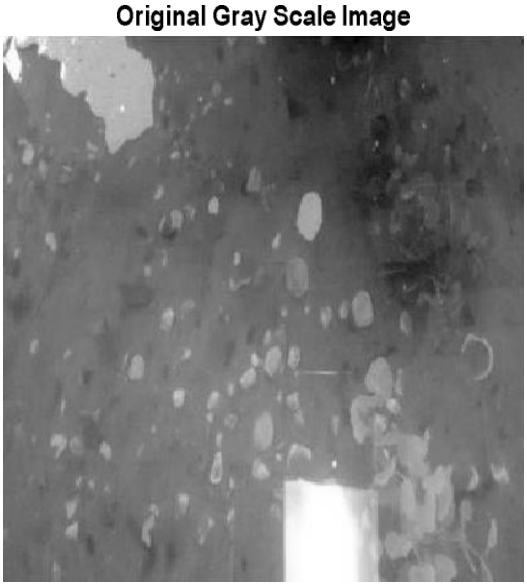

Fig 1(b) Original Gray scale image

$$PSNR = -20 \log_{10} [2^b - 1) / (\sqrt{MSE})]$$

Where 'b' is the number of bits per sample Simulations for the proposed algorithm is done with the support of MATLAB Image Processing toolbox.

Fig 2(a) Noise iamge

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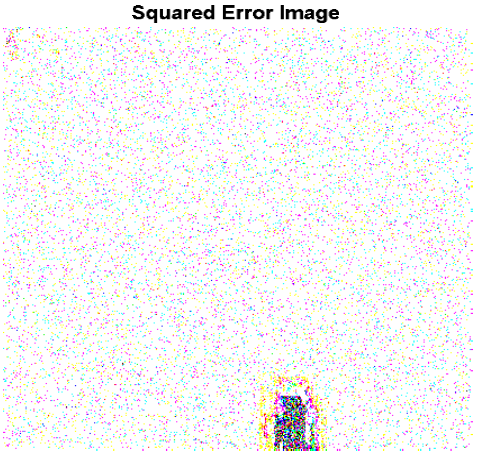
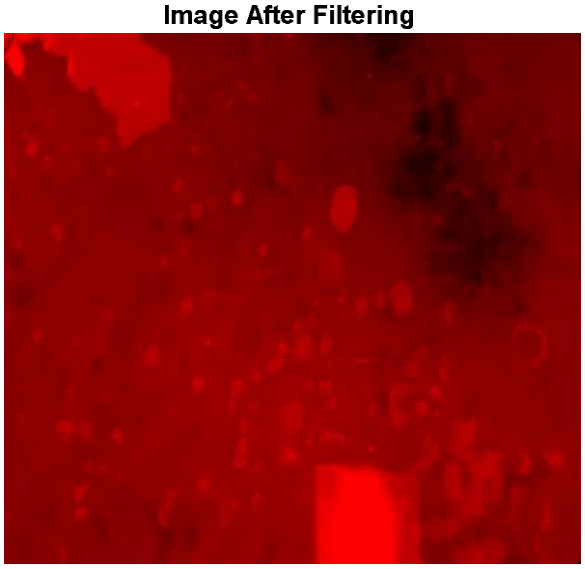


Fig 2 (b) Squared error noise image

Table 1 : Performance metric of Underwater image before and after applying Proposed Algorithm

Description	PSNR	MAE
Noisy image	31.51	25.3
Squared Error of Noisy Image	30.62	25.3
Filtered Image	193.9	5.53
Squared Error of Filtered Image	191.1	5.53

Table 1 shows the value of the PSNR and MAE for the noise and filtered images. From this table, it is observed that, the PSNR value is increased significantly and MAE value also minimized considerably for the noisy images and filter images. From this experiment, it is analyzed as the median filter have the capability to filtered out the noise present in the underwater images. Figure 1 (a) shows the original colour image captured from the water tank with height of the 4ft filled water for 3ft and camera kept 2 ft above the water level. Figure 1(b) shows the gray scale of the original image. The purpose of the converting original color image to gray image is to apply median filter, because , this filter will works for the gray scale only. Figure 2 a and b show that the addition of salt and pepper noise with the



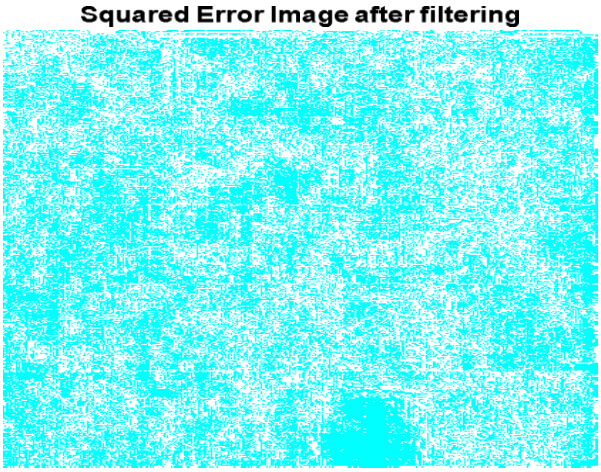
original image and respective squared image

Fig 3(a) Image with proposed algorithm respectively. Finally figure 3 a and b shows that filtered images using median filter and squared image respectively.

Fig 3 (a) Squared error image after filtering

V Conclusion

The simulation result show that the proposed median filter performs the well and give the pleasant image by removal of salt and pepper noise and other noise from the degraded underwater images. The PSNR value is increased from 30 to 191 and MAE is also considerable minimized from 25 to 5. By using the median filter, the noise is eliminated notably. This enhancement still can be improved by



employing some other enhancement algorithms like Non Local means algorithm [5],. This work can be extended by using deep learning algorithm.

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