Haze Removal and Color Compensation of Underwater Image with Denoising Algorithm

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Abstract- Capturing image in underwater is challenging due to haze caused by light that is reflected from surface and is deflected and scattered by water particles. Shading changes because of light weakened for various frequency .This paper proposes a novel precise way to deal with improve submerged pictures by a dehazing calculation, to repay the lessening error along the proliferation way, and to take the impact of the conceivable presence of a counterfeit light source into thought. When the profundity map, i.e., distances between the articles and the camera, is assessed, the forefront and foundation inside a scene are sectioned. The light powers of closer view and foundation are contrasted with decide if a counterfeit light source is utilized during the picture catching interaction. After compensating the effect of artificial light, the haze phenomenon and discrepancy in wavelength attenuation along the underwater propagation path to camera are corrected. Effect of noise is also reduced by using the frequency filter. The Haze Removal and Color Compensation with Denoising algorithm proposed in this dissertation can effectively restore image color balance and remove haze.Using this technique the visibility and color of the image can be enhanced.

Keywords: - Color Change, Wave Length, Under Water Image

I. INTRODUCTION

An image in the real world is a function of two dimensional function f(x, y) where f is the amplitude (e.g. brightness) of the image at the spatial coordinate position (x, y). Further, an image is a collection of sub images sometimes noted as regions-of-interest (ROI) or simply regions. When amplitude and spatial coordinates both are discretized, it is called digital image [1].

Image Enhancement improve the perception or interpretability of the information in images for human observers and the output of image enhancement provide input for other computerized image processing techniques. The basic purpose of enhancing image is to modify the attribute of the image so that it becomes more suitable for a specified task and a specific viewer. One or more than one attributes of the image are modified in this process,. The chosen attributes and the modification method are specific to a particular task. Observer-specific factors helps on selection of image enhancement method, such as the viewer's experience and the human visual system [2]. Understand and analysis of images of all type Image Enhancement can be applied. For example satellite imaging analysis and analysis of medical image etc.

Figure 1: Above figures show the Captured image and its Enhanced Image Captured Image Enhanced Image.

There are certain limitations in the human visual system in its capacity to perceive information transferred by images. Visual system face difficulties to detect contrast and brightness which are lower than a definite contrast sensitivity threshold. Its resolving power is also limited. It cannot examine images that are distorted by noise, especially by impulse noise or highly coordinated noise patterns. On the other hand, visual system is capable to perceive colors, it contains 3D capacity by stereo vision, and it is capable of effectively detecting changes in the images with in time. To perceive information visual system has five channels per pixel: three for Red, Green and Blue colors and additional two for stereo and dynamical vision.

Image enhancement converts images into a form that extends the capabilities of human visual system so that it can perceive information in their maximum degree.

Theoretically, image enhancement methods may be considered as an extension of image restoration methods. However, the basic difference in the image restoration and enhancement is, image enhancement usually demands intended manipulated image signal such as overemphasize color contrasts and brightness, it needs to eliminate certain details that may hide important objects and converting gray scale images into color, stereo etc . Visual image analysis provides the best results if the feedback from the user is received to the image processing system[3].

II. UNDERWATER IMAGE ENHANCEMENT

Beneath the shimmering surface of oceans, seas, lakes, rivers lies an awe-inspiring world. Underwater photography enables the average person to get a small peek to this lovely world. Some underwater photography might capture oceanic wildlife, like fish and plants, while other underwater photographs focus on the landscape. Underwater photographs also allow humans to capture images of long forgotten manmade structures and objects. Haze and color change in the underwater image lowers its visibility and contrast. In underwater environment haze and color change occurs because of two reasons [24].

a) There are many particles such as sand, minerals and planktons exist in the rivers, lakes and oceans. As light that is reflected from the objects propagates towards the camera, a portion of light meets these particles .These particles absorbs some part of the light and disperse the light beam as in figure 2.

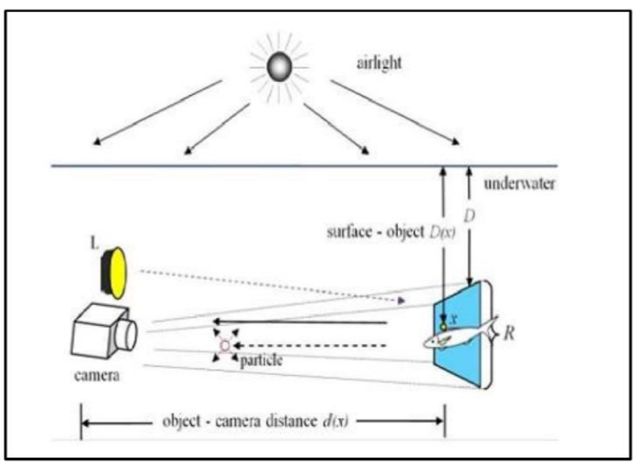


Figure 2: The distance between scene and camera is d(x).

Color change due to varying degree of depreciation in the different wave lengths. Underwater images are influenced by blue color because blue color travels longest in the water due to its shortest wavelength. Change in the color result in deviation of color in images acquired underwater [8].

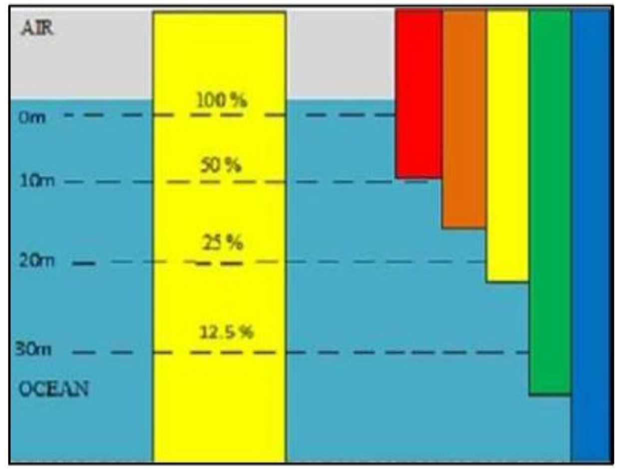


Figure 3: Different wavelengths of light are attenuated at different rates in water.

III. PROPOSED METHODOLOGY

Dark Channel Prior method is used to estimate the transmission and then we apply dehazing process to enhance underwater image. The underwater image suffers from low contrast and resolution due to poor visual conditions, hence an object recognition become difficult task so the contrast of the resulted image is enhanced by using contrast stretching that results a more clear image. The de-noising process is applied by using Gaussian High Pass Filter in Frequency Domain. The flow chart of HRCCD algorithm is presented below:

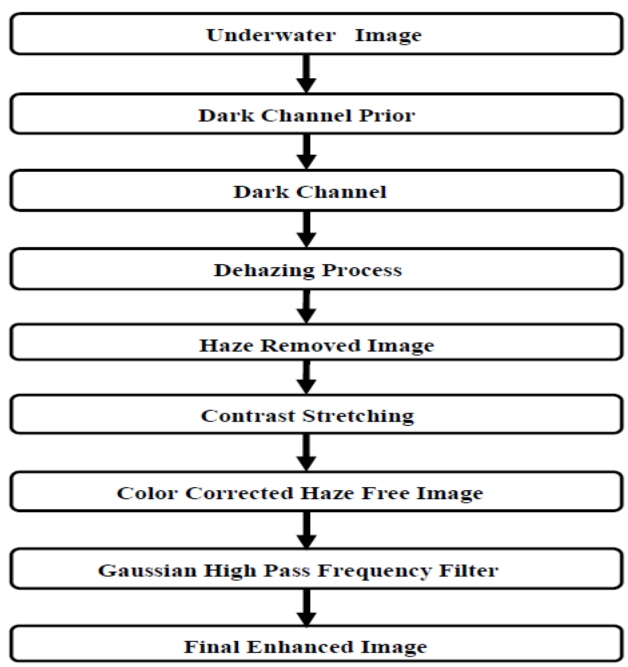
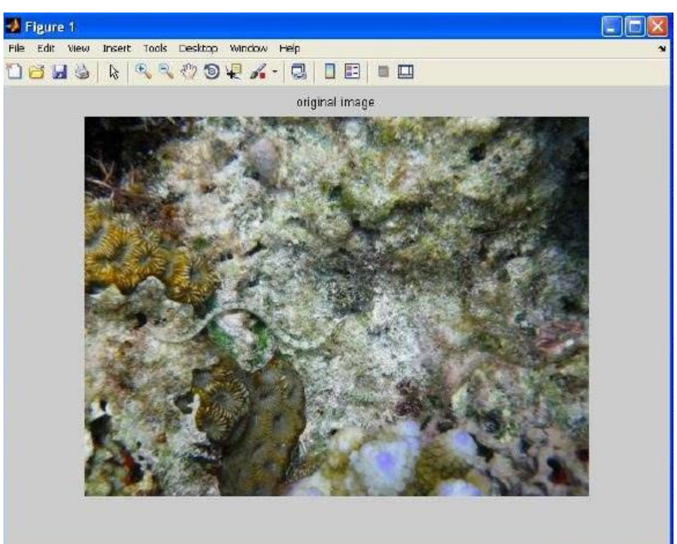


Figure 4: F low chart of proposed algorithm

Contrast stretching is also called as normalization. It is a simple enhancement technique in which contrast in an image is improved by stretching the range of intensity values [3]. Contrast is stretched between the limit of lower threshold and upper threshold. It is an intensity based contrast enhancement method, where the intensity of the original image is transformed using a specific function, which will generate an
enhanced output image. This algorithm makes bright portions brighter and dark portions darker. Color correction is performed by equalizing each color means. This is carried out by stretching the range of the color values to make use of all possible values.

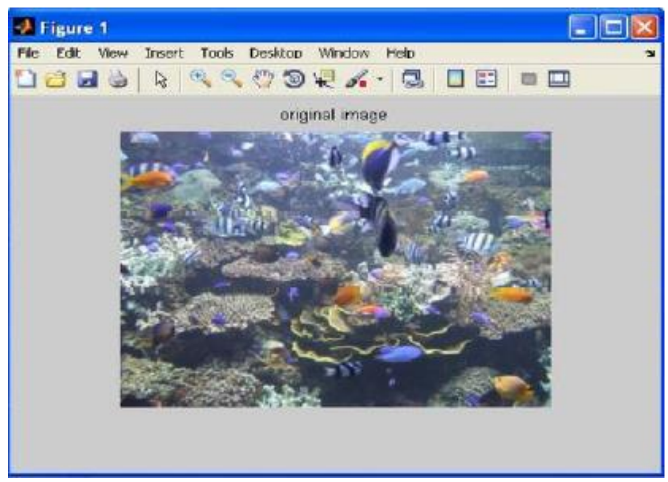
IV. EXPERIMENTAL RESULTS

Peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. The PSNR block computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image.
The higher PSNR resulted better quality of the compressed or reconstructed image. The MSE (Mean Square Error) represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error. The lower value of MSE results lower the error. Different color image enhancement techniques can be compared by taking parameters Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR).



Snapshot-1: Figure represents the original image 1

The function for calculation of Peak Signal to Noise Ratio function [psnr,mse]=psnr(ImageA,ImageB) if (size(ImageA,1) ~= size(ImageB,1))
or (size(ImageA,2) ~= size(ImageB,2)) error('ImageA <> ImageB'); dpsnr = 0;
return ; end
ImageA=double(ImageA);
ImageB=double(ImageB);
M = size(ImageA,1); N = size(ImageA,2); mse = 0 ; for k=1:3 for i = 1:M for j = 1:N mse = mse +
(ImageA(i,j) - ImageB(i,j)).^2 ; end end end dpsnr = 10*log10((M*N*max(max(ImageA.^2)))/mse) ;
psnr=sum(abs(dpsnr))/3; mse=mse/(M*N); return
That can be called by-
[PSNR,MSE]=psnr(imageRGB,M);
PSNR=num2str(PSNR); msgbox(['PSNR=' PSNR],'PSNR Calculation'); Peak Signal to Noise



Snapshot-2: Figure represents the original image 2

The comparison of PSNR values of different color correction methods is done. The proposed algorithm resulted higher PSNR value, means it produces better quality of image. Result analysis for images in terms of PSNR values is tabulated as below:

Table1: Comparison of PSNR value of different methods for image 1

S. No.	Methods	PSNR Value
1	Measurement Between Original & Noisy	13.56
2	Homomorphic Method	14.10
3	Homomorphic Method with Thresholding	17.59
4	Gaussian Surround	24.35
5	Laplacian Distribution	24.27
6	Gamma Distribution	25.21
7	Histogram Equalization	31.27
8	Dark Channel Prior Method	26.94
9	**HRCCD Algorithm.**	**43.47**

V. CONCLUSION

The Haze Removal and Color Compensation with Denoising algorithm proposed in this dissertation can effectively restore image color balance and remove haze. The experimental results demonstrate superior haze removing and color balancing capabilities of the proposed HRCCD over traditional dehazing and color correction methods. This approach is physically valid and is able to recover distant objects even in the heavy blurry image without any pre-configuration and this approach works for both gray scales as well as color Images. There may be compensation errors because of the estimation of the scene depth d(x) using the dark-channel prior; it encounters the scene depth by using single image. Relatively large white shiny regions of a foreground object might be misjudged as far away ones. Two approaches are suggested to reduce the above situation .One is increase the size of the local patch Ω(x) that is formulated in haze equation. Another is to refine the depth by using spatial and temporal correlation within and between video frames.

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