Review paper on Haze Removal and Color Compensation of Underwater Image

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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. Color changes due to light attenuated for different wavelength .This paper proposes a novel systematic approach to enhance underwater images by a dehazing algorithm, to compensate the attenuation discrepancy along the propagation path, and to take the influence of the possible presence of an artificial light source into consideration. Once the depth map, i.e., distances between the objects and the camera, is estimated ,the foreground and background within a scene are segmented .The light intensities of foreground and background are compared to determine whether an artificial light source is employed during the image capturing process. After compensating the effect of artificial light, the haze phenomenon and discrepancy in wavelength attenuation along the underwater propagation path to camera are corrected. Next, the water depth in the image scene is estimated according to the residual energy ratios of different color channels existing in the background light. Based on the amount of attenuation corresponding to each light wavelength, color change compensation is conducted to restore color balance. Effect of noise is also reduced by using the frequency filter.

Keywords:- Haze Removal, Color Compensation, Underwater Image

I. INTRODUCTION

The frequencies of the periodic parts of the image will reflected by the Fourier transform of an image. By masking or filtering out the unwanted frequencies one can obtained a new image by applying the inverse Fourier transformation. A filter is a type of matrix that have same dimension that the Fourier transform of the padded image has. The components of the filter I are normally ranges from 0 to 1. The frequency whose component is 1 is allowed to pass.

Three main types of filters are high pass, low pass and band-reject. They are represented in the following figure where the low frequencies are represented in the middle and one is representing the diagonal section of the matrix of filter.

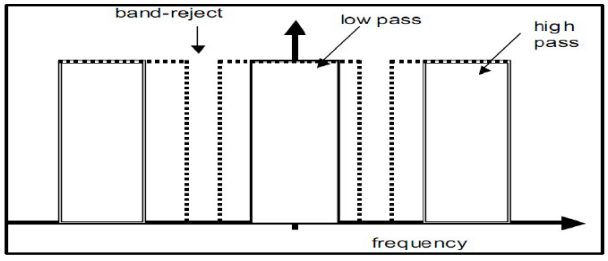

Figure 1: Filter

The above filters contain jumps and are often called “ideal” filters. The important filters that make use of polynomial and exponential approximations are the Butterworth and Gaussian filters. Underwater photography is a more important for ocean engineering [7]. It is used to scientific research such as census of population, assessing geological environments, monitoring the sea life. Haze brings troubles to many computer vision/graphics applications. It reduces the visibility of the scenes and lowers there liability it reduces the clarity of the Underwater Images [8]. In underwater environment haze and color change occurs because of two reasons:

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 [9] .These particles absorbs some part of the light and disperse the light beam. When the blackbody radiation [10] is not present, the multiscattering process with propagation also scatters the beam into homogeneous background light.

b) Color change due to varying degree of depreciation in the different wave lengths. Therefore, removing haze from images is an important and widely demanded topic of ocean engineering. Underwater image enhancement techniques provide a way to improving the object identification in underwater environment.

Haze Removal and Color Compensation of Underwater Image with Denoising (HRCCD) algorithm propose a method to remove the haze caused by light distortion as well as it also corrects change in the color. HRCCD

algorithm uses existing scene depth derivation method that is Dark Channel Prior method
to recover the scene radiance. The pixels with low intensity value in the dark channel are mainly because of following three factors: Shadows, Colourful objects or surfaces, Dark objects or surfaces. Dark channel method provides transmission estimation, estimation of background light, recovery of scene radiance. The haze removed image is obtained by The Dark channel method. Then color distortion is corrected by using contrast stretching technique. Almost all images contain some amount of noise that is unwanted variation on the image quality. After noise removal image will be more clear and visible.

II. LITERATURE REVIEW

In 2006 Stephane Bazeille, Isabelle Quidu, Luc Jaulin, Jean-Phillipe Malkass [11] present a novel underwater pre-processing algorithm that is as follows:
First of all Moir´e pattern is deleted by a spectral analysis by determine peaks in the Fourier transform and removing them assuming that Moir´e effect is represented by them.
Potential border effects does not occurs in symmetric extension and resizing to squared image, it increase the speeds of the following process by using fast wavelet transform and fast Fourier transform algorithms. Convert the color space to YCbCr (Luminance Chrominance) from RGB. This color space does not allow us to process the three RGB channels but it allows us to work only on one channel. This step again increases all the following processing because it avoids the processing of each RGB channels each time.
Homomorphic filtering is a frequency filtering that is used for correction of non uniform illumination; it
sharpens the edge and enhances contrasts in the image at the same time.
Then it use the wavelet denoising method to remove the Gaussian noise that is present in the natural image and wavelet denoising was used in many others algorithms due to its speed in comparison of its denoising quality. Next, the anisotropic filtering makes image features simple for the improvement in image segmentation.
The image is smoothes in homogeneous area by this filter but it also preserves edges and sharpens them. It smoothes the textures and reduce artefacts by removing small edges amplified by Homomorphic filtering.
They transform the image back to the RGB space after adjusting image intensity to improve contrast and
remove the image's symmetric extension part to recover the image back with original size. This pre-processing algorithm is automatic it does not require any parameters adjustment and does not need any prior information of the acquisition conditions and these filters greatly enhance detection of edges and also visual quality of images is often increased.

In 2012 Norsila bt Shamsuddin, Wan Fatimah bt Wan Ahmad, Baharum b Baharudin1, Mohd Kushairi b Mohd Rajuddin, Farahwahida bt Mohd [19] .It perform color correction by both manual adjustment and auto level adjustment techniques on the respect of thirty underwater images that are taken at 1m, 3m and 5m in water depth. Both manual and auto level techniques record the mean values of the stretched histogram. The purpose of this paper is to recognize which technique is more effective in terms of color correction.
The auto level color correction uses histogram clipping. It contains a threshold value for the desired number of pixels before the histogram is defined as maximum or minimum bins. The manual color level, an initial darkest and brightest values need to be set. On the basis of literature review, the white point will have an initial value of 95% set to the brightness value and the black point will be 5% as the initial value of the brightness. The result shows that the manual enhanced technique is more precise as compared to auto enhanced technique due to the level of significance.
In 2013 Ghada S. Karam Ziad M. Abood Rafal N. Uses a technique comprises a combination of classical contrast enhancement techniques and fuzzy histogram equalization techniques. Fuzzy Histogram Equalization is used to alleviate the effects of edge ringing on the histogram. This is done by using a weighted neighbourhood function when computing the histogram. This means that it builds a histogram for each pixel in the image, using a specified number of surrounding pixels. Firstly, the contrast stretching of RGB algorithm to equalize the color contrast in the images was used.

III. UNDERWATER IMAGE

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 [11].
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.

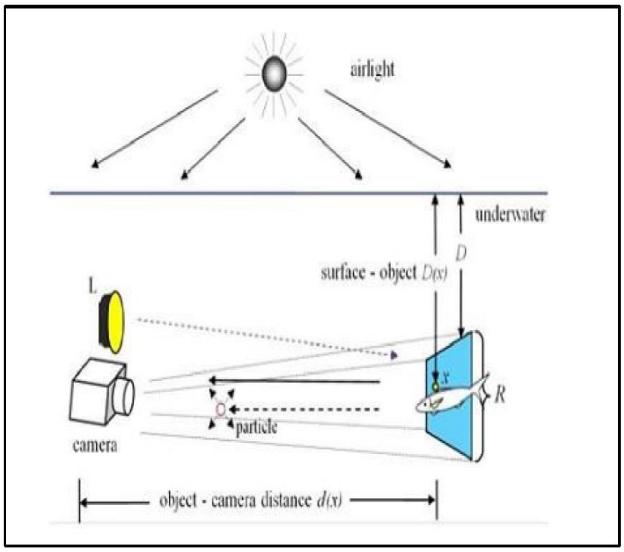

Figure 2: The distance between scene and camera is d(x).The light that enters from air to underwater scene point. The perceived radiance by camera is made by two components: The direct transmission of reflected light and the background light that is formed by multi scattering.

b) 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].

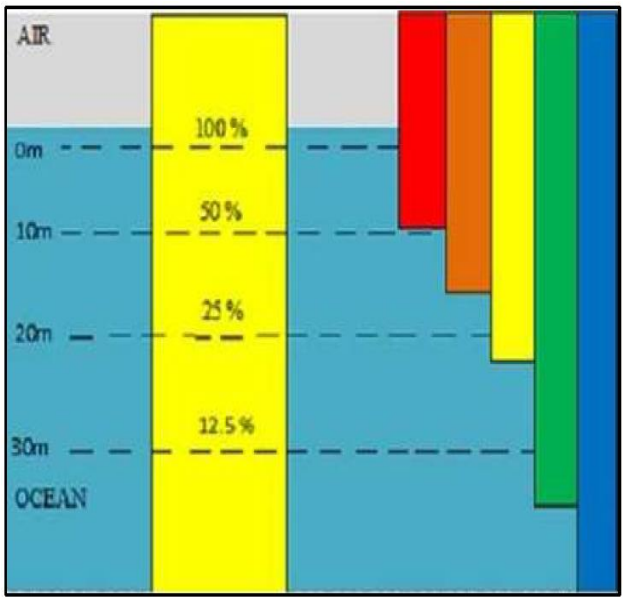

Figure 3: Different wavelengths of light are attenuated at different rates in water. The blue color travels the longest in the water due to its shortest wavelength. This is the reason that underwater images are dominated by blue color

IV. CONCLUSION

There are two main problems in the underwater photography: First is the light scattering due to many particles exist in the water they absorbs the reflection from object and scatter it all around the directions and second is the color distortion due to wavelength attenuation within the water depth, the blue has shortest wavelength so travels longest in the water depth that is why underwater images are suffered from bluish tone. These are the two reason that cause unclear images. To remove distortion caused by light scattering the dark channel method and dehazing process is used. To remove color distortion contrast stretching is used. There may also be blurriness due to many types of noise available that may be reduced by filtering process. The de-noising process is applied by using Gaussian High Pass Filter in Frequency Domain.

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