A REVIEW ON UNDERWATER IMAGE QUALITY ENHANCEMENT USING ADAPTIVE GAMMA CORRECTION WEIGHTING DISTRIBUTION

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***Abstract*— This review paper deals with a process of improving the quality of underwater image. The quality of underwater image is poor due to the properties of water and its impurities. The properties of water cause attenuation of light travels through the water medium, resulting in low contrast, blur, inhomogeneous lighting, and color diminishing of the underwater images. This paper proposes a method of enhancing the quality of underwater image. Ordinary histogram equalization uses the same transformation derived from the image histogram to transform all pixels. This works well when the distribution of pixel values is similar throughout the image. However, when the image contains regions that are significantly lighter or darker than most of the image, the contrast in those regions will not be sufficiently enhanced. The objective is to enhance the underwater images contrast while preserving image brightness. The proposed methods have been tested using several underwater images and gives better visual quality and PSNR value.**

***Index Terms*— Image enhancement, HE, BBHE, PSNR, Adaptive Gamma Correction etc.**

I. INTRODUCTION

Image enhancement is a technique of improving the quality of image by improving its features , stretching the contrast of RGB , stretching the saturation and intensity of HSI to solve the problem of lighting. Underwater image enhancement process is a challenging field because of physical objects of such an environment. Underwater image enhancement techniques provide a way to improving the property or object identification in underwater environment. There is lot of research started for improving the quality of underwater images, but limited work has been done in the area of underwater images. The quality of underwater images get blurred due to poor visibility and effects like absorption or reflection or bending , scattering of light. There are the important reasons which causes the degradation of underwater images. This paper describes the review of development work on the techniques and methods of underwater image enhancement.

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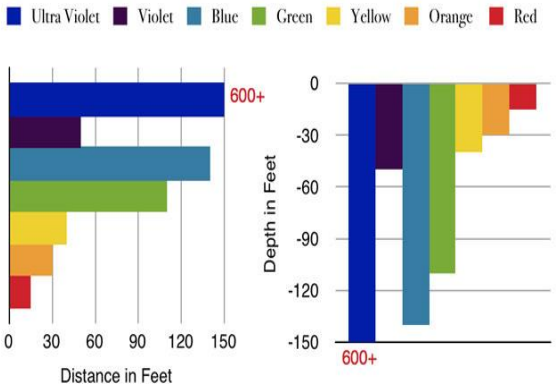


II. ENHANCEMENT TECHNIQUES

(a) Histogram Equalization

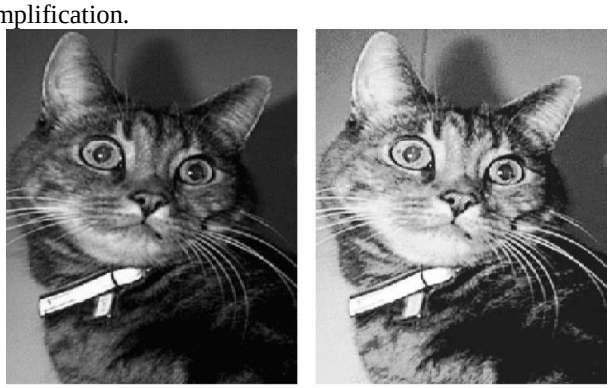
It is a popular technique for improving the appearance of a poor image. It's a function is similar to that of a histogram stretch but often provides more visually pleasing results a cross a wide range of images. Histogram equalization is a technique where the histogram of the resultant image is as flat as possible (with histogram stretching the overall shape of the histogram remains the same). The results in a histogram with a mountain grouped closely together to "spreading or flatting histogram makes the dark pixels appear darker and the light pixels appear lighter (the key word is "appear" the dark pixels in a photograph can not by any darker. If, however, the pixels that are only slightly lighter become much lighter, then the dark pixels will appear darker.This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal. In scientific imaging where spatial correlation is more important than intensity of signal (such as separating DNA fragments of quantized length), the small signal to noise ratio usually

hampers visual detection. Histogram equalization often produces unrealistic effects in photographs.

Enhancement of a color image: (a) original image; and (b) enhanced image.

(b) Adaptive Histogram Equalization

Adaptive histogram equalization (AHE) is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast .However, AHE has a tendency to overamplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.



original after adaptive histogram equalization

(c) Gamma Correction

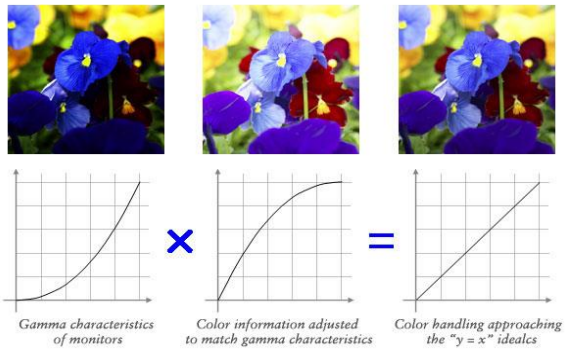
Gamma correction, or often simply **gamma**, is the name of a nonlinear operation used to code and decode luminance or tristimulus values in video or still image systems. Gamma correction is, in the simplest cases, defined by the following power-law expression:

$$V_{\text{out}} = AV_{\text{in}}{}^{\gamma}$$

where A is a constant and the input and output values are non-negative real values; in the common case of $A = 1$, inputs and outputs are typically in the range 0–1. A gamma value $\gamma < 1$ is sometimes called an encoding gamma, and the process of encoding with this compressive power-law nonlinearity is called gamma compression; conversely a gamma value $\gamma > 1$ is called a decoding gamma and the application of the expansive power-law nonlinearity is called gamma expansion. Gamma encoding of images is used to optimize the usage of bits when encoding an image, or bandwidth used to transport an image, by taking advantage of the non-linear manner in which humans perceive light and color. Human vision, under common illumination conditions (not pitch black nor blindingly bright), follows an approximate gamma or power function, with greater sensitivity to relative differences between darker tones than between lighter ones. If images are not gamma-encoded, they allocate too many bits or too much bandwidth to highlights that humans cannot differentiate, and too few bits/bandwidth to shadow values that humans are sensitive to and would require more bits/bandwidth to maintain the same visual quality. Gamma encoding of floating-point images is not required (and may be counterproductive), because the floating-point format already provides a piecewise linear approximation of a logarithmic curve. Although gamma encoding was developed originally to compensate for the input–output characteristic of cathode ray tube (CRT) displays, that is not its main purpose or advantage in modern systems. In CRT displays, the light intensity varies nonlinearly with the electron-gun voltage. Altering the input signal by gamma compression can cancel this nonlinearity, such that the output picture has the intended luminance. However, the gamma characteristics of the display device do not play a factor in the gamma encoding of images and video – they need gamma encoding to maximize the visual quality of the signal, regardless of the gamma characteristics of the display device. The similarity of CRT physics to the inverse of gamma encoding needed for video transmission was a combination of luck and engineering, which simplified the electronics in early television sets.The concept of gamma can be applied to any nonlinear relationship. For the power-law relationship $V_{\text{out}} = V_{\text{in}}{}^{\gamma}$, the curve on a log–log plot is a straight line, with slope everywhere equal to gamma (slope is represented here by the derivative operator):

$$\gamma = \frac{\mathrm{d}\log(V_{\text{out}})}{\mathrm{d}\log(V_{\text{in}})}$$

That is, gamma can be visualized as the slope of the input–output curve when plotted on logarithmic axes. For a power-law curve, this slope is constant, but the idea can be extended to any type of curve, in which case gamma (strictly speaking, "point gamma" is defined as the slope of the curve in any particular region.



(d) Brightness Preserving Bi-Histogram Equalization (BBHE):

In this technique, the input image is decomposed and two sub images are formed on the bases of mean value. One Sub image contains the set of samples that are less than or equal to mean whereas the other sub image is the set of samples greater than mean. Then the method equalizes both sub images independently according to their respective
histograms with a constraint that samples in the first sub image are mapped in the range from minimum gray level to

input mean and samples in second sub image are mapped in the range from mean to maximum gray level. That means one sub image is equalized over the range up to mean and other sub image is equalized over the range from mean based on the respective histograms. The resultant equalized sub images are bounded by each other around input mean, which has an effect of preserving the mean brightness .BBHE has an advantage that it preserves mean brightness of the image while enhancing the contrast and, thus, provides much natural enhancement that can be utilized in consumer electronic products.

III. LITERATURE SURVEY

Dr. D. Deepa, V.L.Sangameshwari (Sept. 2014), The quality of underwater images is poor because of specific propagation properties of light in water. So, underwater image enhancement is necessary to increase visual quality. Image enhancement can be done in two domains. Spatial domain and frequency domain. Various approaches like contrast stretching, adaptive histogram equalization, EMD (Empirical Mode Decomposition), UCM techniques are used to enhances the underwater images. Some filtering techniques are also used to avoid the noise in the sea image.

Sowmyashree M S, Sukrita K Bekal (May 2014) The major sources for distortion of underwater images are light scattering and color change. This leads to one color dominating an image. Water has high refractive index when compared to air. Therefore when light is incident on water, it gets refracted. Hence, underwater images suffer from limited range visibility, low contrast, blurring, color diminished and noise. One method of improving the image quality is by image enhancement. This paper presents a comparative study of the various image enhancement techniques used for enhancing underwater image.

Shiwam S. Thakare, Amit Sahu (April 2014) Image enhancement is a process of improving the quality of image by improving its feature. In this paper comparative analysis of various enhancement techniques for such underwater images is presented. The underwater image suffers from low contrast and resolution due to poor visibility conditions, hence an object identification become typical task. The processing of underwater image captured is necessary because the quality of underwater images affect and these images leads some serious problems when compared to images from a clearer environment. A lot of noise occurs due to low contrast, poor visibility conditions, absorption of natural light, non uniform lighting and little color variations, and blur effect in the underwater images, because of all these reasons number of methods are there to cure these underwater images, different filtering techniques are also available in the literature for processing and enhancement of underwater images.

Pooja Sahu , Neelesh Gupta (Feb 2014) This review paper deals with the methods to improve underwater image enhancement techniques, the processing of underwater image captured is necessary because the quality of underwater images affect and these image leads some serious problems when compared to images from a clearer environment. A lot of noise occurs due to low contrast, poor visibility conditions (absorption of natural light), non uniform lighting and little color variations, pepper noise and blur effect in the underwater images because of all these reasons number of methods are existing to cure these underwater images different filtering techniques are also available in the literature for processing and enhancement of underwater images one of them is image enhancement using median filter which enhances the image and help to estimate the depth map and improve quality by removing noise particles with the help of different techniques, and the other is RGB Color Level Stretching have used. Forward USM technique can also be used for image enhancement.

Diwakar Shrivastava, Dr. Vineet Richhariya (Feb 2014) Image enhancement is one of the most key issues in high quality pictures such as digital cameras and image research area. Since image clarity is very easily affected due to lighting during image acquiring, weather, or other equipment that has been used to capture the image. These conditions lead to image may suffer from poor contrast and noise . so it is necessary to enhance the contrast and remove the noise to increase image quality. The main purpose of image enhancement is to bring out detail that is hidden in an image or to increase contrast in a low contrast image. In this paper, we propose a novel adaptive fuzzy contrast enhancement technique based on the fuzzy entropy principle and fuzzy set theory for low contrast grayscale imagees. We have conducted experiments on many gray scale images of poor quality. The performances of the proposed method are compared with the other methods .The experimental results show that the proposed algorithm is very effective in contrast enhancement as well as required minimum processing time than the other methods.

Kashif Iqbal, Rosalina Abdul Salam (Nov. 2007) In underwater situations, clarity of images are degraded by light absorption and scattering. This causes one colour to dominate the image. In order to improve the perception of underwater images, we proposed an approach based on slide stretching. The objective of this approach is twofold. Firstly, the contrast stretching of RGB algorithm is applied to equalize the colour contrast in images. Secondly, the saturation and intensity stretching of HSI is used to increase the true colour and solve the problem of lighting. Interactive software has been developed for underwater image enhancement. Results of the software are presented in this paper.

IV. PROBLEM FORMULATION

- Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, improves sharpen, or brighten an image, making it easier to identify key features.
- There are some drawbacks of different image enhancement techniques. Image enhancement technique that is Adaptive histogram produces blurred and washed out images especially at the edges. Whereas alpha rooting produces over-graying enhanced images so to overcome all these drawbacks. One drawback of the histogram equalization can be found on the fact that the brightness of an image can be changed after the

histogram equalization, which is mainly due to the flattening property of the histogram equalization.

- In underwater situations, clarity of images are degraded by light absorption and scattering. This causes one color to dominate the image. In order to improve the perception of underwater images, we proposed an approach based on slide stretching.

- Proposed method is gamma correction for underwater image enhancement. The term gamma correction means doing graphics color math accounting for the distortion that the color will eventually go through when displayed on a monitor. Gamma is useful because Gamma encoded images store tones more efficiently. Our eyes do not perceive light the way cameras do. we perceive twice the light as being only a fraction brighter and increasingly so for higher light intensities (a "nonlinear" relationship).

V. OBJECTIVE

Light scattering and color change are two major sources of distortion for underwater photography. Light scattering is caused by light incident on objects reflected and deflected multiple times by particles present in the water before reaching the camera. This in turn lowers the visibility and contrast of the image captured. This can be achieved by using the Adaptive Gamma Correction as they enhance the contrast using intensities.

Our Objectives are as follows:

- The objective is to enhance the under water images contrast while preserving image brightness.
- To apply histogram equalization to enhance the different properties.
- To apply BBHE, RESWHE with Gamma Correction techniques.

CONCLUSION

Underwater image enhancement techniques provide a way to improving the property or object identification in underwater environment. There is lot of research started for improving the quality of underwater images, but limited work has been done in the area of underwater images. There are some drawbacks of different image enhancement techniques. Image enhancement technique Adaptive histogram produces blurred and washed out images especially at the edges. Whereas alpha rooting produces over-graying enhanced images so to overcome all these drawbacks. One drawback of the histogram equalization can be found on the fact that the brightness of an image can be changed after the histogram equalization, which is mainly due to the flattening property of the histogram equalization. The different reviews are studied from the different papers. In the future work the different techniques like BBHE, RESWHE with Gamma Correction applied to enhance the images.

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