A Review Paper on Underwater Image Enhancement

Sapna Yadav[1] Bhupendra Verma[2]
[2]Assistant Professor
[1,2]Department of Electronics & Communication Engineering
[1,2]NITM Datiya, India

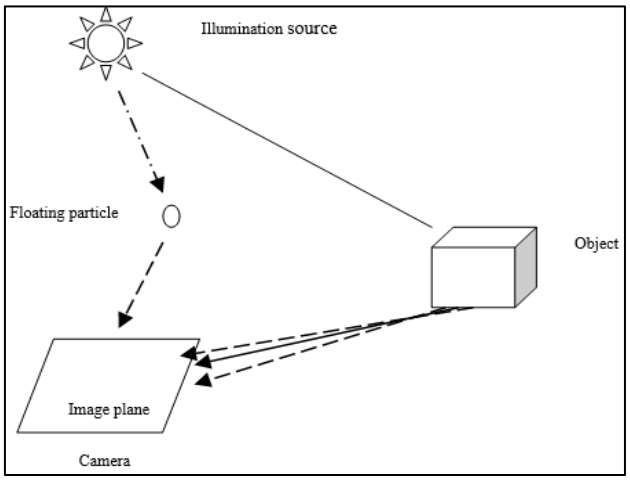
Abstract— Enhancement of underwater images (UI) is the area that takes tremendous attention in research field. Underwater image enhancement (UIE) can be done by eliminating noise, brighten and sharpening. This paper represents various techniques applied on UIs in order to enhance them, issues (problems) regarding underwater images and comparative study of various techniques. Also this paper describes why the underwater images have issues regarding picture quality. The techniques represents in this paper supports in UIE to the great extent.

Key words: Histogram Equalization, Contrast Stretching, Underwater Image Enhancement

I. INTRODUCTION

Underwater Imaging is challenging field of photography. Photographer wants very functional accessories and methods to take picture deep down the ocean. At present underwater activities are important to scientists. They discover and recognize the activities by UIs. Current research represent that UIs carry new challenges and enforce significant problems due to light absorption and diffusion effects of the light.[1] Reason behind this is that, the images head to become bluish as they go down deeper on to the sea for taking photos. Processing on underwater images is typical task due to there is need of showing real underwater images. Marine Researchers studies the impact on sea life by currents and ocean tides. It can be done by using Global Positioning System and various underwater visual devices. By using all sorts of functional tools and photography technique shown above will help diver photographer to take better images but remembering it needs a lot of endowments. Indigent clarity and loss in color comes if the photographer has fewer financial source taking photos using normal digital camera. Therefore, it's miles critical to have some other alternative to visualize the underwater habitat for folks who are unable to spend on unique equipment to take UIs.

A. Underwater Image Enhancement



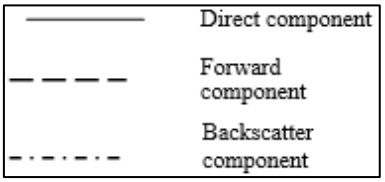


Fig. 1: Diagram showing underwater optical imaging components. They are direct component, forward component and backward scatter component.

It refer to as the removal of noise, sharpening and brighten the pictures. While capturing images in sea, many problems occur to take good quality of image hence UIE is a technique cast-off to attain better quality pictures taken in deep sea. Following is the figure showing components of underwater optical image.

II. APPLICATION

[3] This technique useful for several other applications and is discussed as follows,

A. Matching images by local feature points

It is a most basic task of many visual applications of computer. The SIFT operator for an initial pair of UIs are employed. In both cases, the application of original SIFT is done in the same way. It mainly restores both global contrast and local features of UIs.

1) Segmentation

Segmentation technique divides pictures on to disarticulate and undeviating realm along aspect to some characteristics (like- texture, color). This task demonstrates that our technique does not introduce halos close to object boundaries. Image dehazing-Image Dehazing is a mechanism of elimination of the haze and fog effects from the spoilt images. Because of kinship bounded by hazy and underwater environments because the light scattering process, since the underwater light propagation is more complex that image dehazing could be seen as a subclass of the UI restoration problem.

III. PROBLEMS IN UNDERWATER IMAGES

Some difficulty comes all through UIs for example light absorption and scattering. The deep rooted design of ocean also composes complications in UIs. On the design of the ocean, the reflection of the light changes. The passel of reflected light is horizontally polarized and it halfway gets in the water vertically. Vertical polarization has a significant property that hatch the substance not as great shining and aids to capture deep colors which may not be possible to capture. One more problem regarding the UIs is related to the density of the water in the ocean because it is considered as 800 bit impenetrable than air. Hence when light travels from the air to the water, it is halfway returned back and in the meantime partially enters the water. As we go deeper into the ocean, the magnitude of light that get in the water starts reducing .The

water molecules absorb assertive magnitude of light and creates problem in capturing images. That is the reason, UIs are get darker as the depth increases. The color with shorter wavelength travels large distance as compared to long wavelength. This is why the UIs having been dominated only by blue color.[4]

IV. TECHNIQUES

A. Contrast Stretching

Contrast stretching is a technique for enhancing an image that is cast-off to improve, enhance the contrast of image by 'stretching' the series of intensity values. Wide range of intensity values present within the image .The minimum pixel value subtracted from the maximum pixel value is called dynamic range of image. i.e. dynamic range of image = Max. Pixel value – Min. Pixel value

Complex histogram equalization is different from contrast stretching. It emphasize on a linear scaling function to the image pixel values.

B. Empirical Mode Decomposition

EMD is a commodious technique. It is hinge on the local moment period function. So, it is suitable to help nonlinear amid with non-stationary data for real-life software. . EMD is connected to the Red, Green, Blue channels independently. The genuine image is break up into several intrinsic mode functions by EMD process and a final residue. The EMD technique is direct. The fundamental procedure is to carry out sifter operations on the new data arrangements until the final data series are stationary.

C. Homomorphic filtering (HF)

The HF is cast-off to fix non-uniform lighting to enforce contrast from the impression. HF is a frequency filtering technique. It is the mostly used system on the grounds that non-uniform lighting and sharpens the image. Where F(x, y) is the function of picture taken by the device, I(x, y) the illumination function and r(x, y) the reflectance function. By multiplying these components filter can reduce the non-uniform illumination present in the picture.

D. Anisotropic filtering (AF)

This mechanism unfolds picture constituents to enhance division of picture. AF smoothest the picture in homogeneous range however reserve edges and updates them. It is cast-off to smooth compositions and eliminate relics by rubbing little edges enhanced by HF.

E. Wavelet denoising by average filter

Wavelet denoising is cast-off to stifle the noise. Alternatively it is described as, the GN are generally present in the camera pictures and alternative category of instrument pictures. On moving the pictures Gaussian noise (GN) can be added. Wavelet denoising gives good results contrasted with other noise removal routines because varying from other methods, it does not assume that the coefficients are independent. No doubt wavelet coefficients in normal pictures have various conditions. Besides there is short reckoning time.

F. Red Channel Method

The crucial target in this technique is on recovering color associated with shorter wavelength. As this is highly expected in contrast of UIs. In this method firstly one has to estimate the color of water. For this purpose take a pixel that lies at the maximum depth along aspect of the camera. This is an assumption that degradation of image based on location of pixel. After estimation of transmission of watertight, the scene is estimated. Then Color correction is done.

G. Histogram equalization (HE)

Modification on intensities of picture and contrast is done in HE method. HE is pragmatic in images with backgrounds and frontal areas that are both bright and dim. It is a simple and laid on the line technique. Disadvantage of this technique is that it also amplifies the background noise present in the image and lead to decrease in the useful signal. It outturn improbable effects in the output images. The core idea behind this method is aligning the gray levels placed on the probability distribution of the input gray levels.

1) Adaptive Histogram Equalization (AHE)

It is cast-off to upgrade contrast in pictures. This mechanism is applied in image processing. Several histograms are evaluated by this adaptive method. In this each histogram corresponding to a unique portion of the picture. It avail them to reorganize the lightness values of the image. It is suitable in improvement of the local contrast [5]. AHE over amplify noise in consistent arena of a picture. Contrast limited AHE is a variation of AHE by limiting amplification.

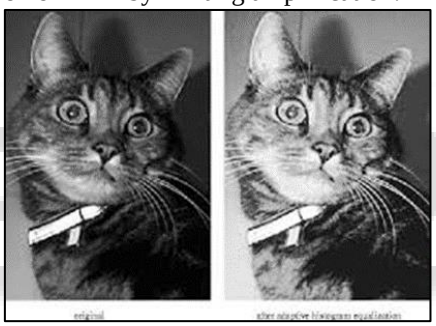


Fig. 2: Showing ADHE

2) Brightness Preserving Bi-Histogram Equalization (BBHE)

In this technique, Input image is decomposed into two sub images that built on the bases of mean value. One Sub picture include the group of constituent that are lesser or equal to mean whereas the other sub picture is the group of constituent greater than mean[3]. This method communize one and the other sub images one at a time regarding to their respective histograms with a coercion that constituent in the first sub image are charted in the range from minimum gray level to input mean , alternatively the constituent in second sub image are charted in the range from mean to maximum gray level. This method has the power to uphold mean brightness of the image while enhancing the contrast providing much natural enhancement that can be utilized in consumer electronic products.

3) Contrast Limited Adaptive Histogram Equalization (CLAHE)

It is generalized technique. By this method the image is divided into tiles. The gray scale is calculated for each tile on the basis of its histogram and transforms function that derives from the interpolation between the manipulated histograms of near-by sub-regions. CLAHE limits the noise enhancement by cut-out the histogram at a client.

a) CLAHE on HSV

HSV color model defines colors in particulars of the Hue (H), Saturation (S), and Value (V). HSV color model is cylindrical-coordinate representing points in an RGB color model. CLAHE is applied on V and S components.

b) CLAHE on RGB color model

RGB color model is an additive color model which represents hues regarding the measure of red, green and blue existence. CLAHE can be implemented to all the three parts i.e. red, green and blue separately. On combining the individual components of model full color effect RGB can be consummate.

H. Integrated Color Model

The integrated color model is built on color harmonizing through contrast improvement is color space of RGB and color adjustment in HSI model. In integrated color model firstly one has to eliminate the color cast by the equalization of all the color values present. Secondly, an improvement is applied to the contrast amendment to broaden the histogram values of the red color. Further it is done for green and blue colors.

V. LITERATURE SURVEY

[6] The balancing of colors will reproduce colors more attractive compared with other methods of auto level. Usually, there are distorted colors on the image occurred due to poor light and water quality. So it requires an enhancement process to get a proper picture to display. This research offers an improved method of auto levels to generate stunning pictures. This method uses the color balancing based on the distribution of each channel R, G and B based on its histogram.

[7] Contrast is the ocular divergence that causes an object detectable from background and other objects. Variety of image contrast enhancement methods is studied for low contrast images. For example - HE, contrast stretching etc. despite the traditional HE technique usually used for excessive contrast enhancement (CE).

[8]Homomorphic filtering (HF)-It is one such technique for removing multiplicative noise that has certain characteristics. It is most commonly used for correcting non-uniform illumination in images. The illumination reflectance model of picture formation says that the intensity at any pixel, which is the amount of light reflected by a point on the object, is the product of the illumination of the scene and the reflectance of the object(s) in the scene, i.e., I(x,y)=L(x,y) R(x,y) Where I is the image, L is scene illumination, and R is the scene reflectance. Reflectance occurs from the characteristics of the objects themselves but illumination concludes from the lighting situation at the time of image sweep. The irregular illumination can be compensated by eliminating the illumination component and preserving only the reflectance component.

[9]Anisotropic denoising focuses on the conservation of significant surface features like sharp edges and corners by employing smoothing relying on direction. For example, a sharp edge leftover sharp on smoothing across the edge.

[10]The most significant characteristics of a picture noise removing model are that it should fully eliminate noise as far as possible as well as uphold edges. DWT is omnipotent strategy in the arena of denoising. PSNR of image gets reduces with increasing in number of levels whereas Mean Absolute Error and MSE get increased.

[11] A Red Channel methodology is proposed to restore the underwater images in which colors along short wavelengths are recovered. Recovery of the lost contrast also done by red channel mechanism. The Red Channel method can be explained as a variation of the Dark Channel mechanism cast-off to images vulgarized by the atmosphere.

[12]HE is a effortless and universally used contrast enhancement technique. These techniques uphold the brightness on the output image but it cannot attain a natural or true look. To blown away this complication Multi-HE methods are cast-off that break the image into proportionate sub images and classical HE method is adapted to each sub picture.

YEAR	AUTHOR	TITLE	APPROACH	RESULT
2014	Pooja Sahu, Neelish Gupta ,Neetu Sharma	**A Survey on Underwater Image Enhancement Techniques**	RGB Color Level Stretching	Enhance the color contrast of the object in underwater and remove different noise particles
2013	Pulung Nurtantio, Andono, Ketut Eddy Purnama, Mochamad Hariadi	Underwater Image Enhancement Using Adaptive Filtering For Enhanced Sift-Based Image Matching	Adaptive Filtering For Enhanced Sift-Based Image Matching	success of SIFT increased by 41% compared to the reference method
2012	Chiang, J.Y.; Ying-Ching Chen	Underwater Image Enhancement by Wavelength Compensation and Dehazing	Wavelength Compensation and Dehazing	Dehazing and improvement in quality in deep water.
2011	Hung-Yu Yang; Pei-Yin Chen Chien-Chuan Huang; Ya-Zhu Zhuang; Yeu-Horng Shiau	Low Complexity Underwater Image Enhancement Based on Dark Channel Prior	Dark Channel Prior	Decrease in implementation time
2010	Dr.G.Padmavathi, Dr.P.Subashini, Mr.M.Muthu Kumar and Suresh Kumar Thakur	Comparison of Filters used for Underwater Image Pre-Processing	Filtering method	Enhance and smoothen the image

Table 1: Comparative Table [13]

VI. CONCLUSION

Taking a beautiful underwater image requires extraordinary equipment and technique. Hence we use various methods in pursuance of enhance underwater images. RGB Color Level Stretching Enhances the color contrasts of the object in underwater and remove Different noise particle. By Adaptive Filtering for Enhanced Sift Based Image matching success of SIFT increased by 41% compared to the reference method different noise particles. Through Wavelength Compensation and Dehazing improvement in quality in deep water can be achieved. Dark Channel Prior Decreases implementation time. Filtering method Enhances and smoothen the image.

REFERENCES

[1] Kashif Iqbal, Rosalina Abdul salam, Azam osman and Abdullahzawawiralib, IAENG International Journal of computer science, 34:2, IJCS 34 2 12

[2] Raimondo Schettini andSilvia Corchs," Underwater Image Processing: State of the Art of Restoration and Image Enhancement Methods, EURASIP Journal on Advances in Signal Processing, 2010:746052, DOI: 10.1155/2010/746052

[3] Cosmin Ancuti, Codruta Orniana Ancuti, Tom Haber and Philippe Bekaert,"Enhancing Underwater Images and Videos by Fusion", 978-1-4673-1228

[4] Norsila bt Shamsuddin, Wan Fatimah bt Wan Ahmad, Baharum b Baharudin, Mohd Kushairi b Mohd Rajuddi, Farahwahida bt Mohd, Publisher Name Springer, Berlin, Heidelberg
[5] Er. Charanjeet Kaur, Er. Rachna Rajput," A Review on Underwater Image Quality Enhancement Using Adaptive Gamma Correction Weighting Distribution", International Journal of Engineering Research And Management (IJERM) ISSN: 2349- 2058, Volume-02, Issue-05, May 2015.
[6] Achmad Basuki, Nana Ramadijanti, "Improving Auto Level Method for Enhancement of Underwater Images"
[7] Ms. K.T.Chalekar, Prof T. Yengantiwar," Review Paper on Image Contrast Enhancement Techniques", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 3 Issue 3, March 2014, ISSN: 2278 – 1323
[8] Mrs. R.Swarnalakshmi, Mr. B.Loganathan," A Survey on Under Water Images Enhancement Techniques", International Journal of Computer Science & Engineering Technology (IJCSET), ISSN: 2229-3345
[9] Klaus Hildebrandt, Konrad Polthier", Anisotropic Filtering of Non-Linear Surface Features", c The Eurographics Association and Blackwell Publishing 2004. Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA., Volume 23 (2004), Number 3
[10] Anutam and Rajni," Performance Analysis of Image Denoising with Wavelet Thresholding Methods For Different Levels of Decomposition, The International Journal of Multimedia & Its Applications (IJMA) Vol.6, No.3, June 2014, DOI : 10.5121/ijma.2014.6303
[11] Adrian Galdrana , David Pardob , Artzai Picon,Aitor Alvarez-Gila," Automatic Red-Channel Underwater Image Restoration", TECNALIA Research & Innovation, Parque Cient´ıfico y Tecnol´ogico, Edificio 202, E-48170, Zamudio, Spain, November 12, 2014
[12] Dr. A. Sri Krishna, G. Srinivasa Rao and M. Sravya," Contrast Enhancement Techniques using Histogram Equalization Methods on Color Images With Poor Lightning", International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.3, No.4, August 2013, DOI10.5121/ijcsea.2013.3402
[13] Shiwam S. Thakare1, Amit Sahu,"Comparative Analysis of various Underwater Image Enhancement Techniques", IJCSMC, Vol. 3, Issue. 4, April 2014, pg.33 – 38, ISSN 2320–088X

