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DENOISING AND ENHANCING UNDERWATER IMAGES: A REVIEW

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Abstract*:* Underwater images mainly suffer from the problem of poor color contrast and poor visibility. These problems occurred due to the scattering of light and refraction of light while entering from rarer to denser medium. Scattering causes the blurring of light and reduces the color contrast. These effects of water on underwater images are only not due the nature water but also because of the organisms and other material present in the water. Image enhancement is the process of improving the quality of the input image so that it would be easily understood by viewers in the future. Image enhancement improves the information content of the image and alters the visual impact of the image on the observer. Many techniques and methods are established by researchers to solve the problem of underwater image enhancement. In this paper different underwater image enhancing techniques are reviewed and studied*.*

Keywords: Image enhancement, Contrast stretching, CLAHE, Histogram Equalization, Homomorphic filter, WCID.

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INTRODUCTION

Underwater image enhancement techniques provide a way to improving the object identification in underwater environment [1]. There is lot of research started for the improvement of image quality, but limited work has been done in the area of underwater images, because in underwater environment image get blurred due to poor visibility conditions and effects like “absorption of light”, “reflection of light”, “bending of light, “denser medium ”, and “scattering of light” etc. These are the important factor which causes the degradation of underwater images [2], [3]. According to Anthony [4] the reflected amount of light is partly polarized horizontally and partly enters the water vertically.

When light rays moves from the air to the water, it is partly reflected reverse and at the same time partly enters the water. The total light amount that enters the water also starts reducing start it goes deeper in the sea. Similarly, the water molecules also absorb certain amount of light. As a result, the underwater images are getting darker and darker as the deepness increases [5]. Not only the quantity of light rays is condensed when it goes deeper but also colors drop off one by one depending on the wavelength of the color. The process of the light in water can influence the overall performance of underwater imaging system. Forward scattering generally leads to blurring of the image feathers and backscattering generally limits the contrast of the images. The blue color travels the longest in the water and in depth due to its shortest visible wave length. Which makes the underwater images having been dominated only by blue color because of this effect of blue color the original color of any object under the water is affected[].

II. LITERATURE REVIEW

Galdran et al. proposed a Red Channel method, where colors associated to short wavelengths are recovered, as expected for underwater images, leading to a recovery of the lost contrast. The Red Channel method can be interpreted as a variant of the Dark Channel method used for images degraded by the atmosphere when exposed to haze [6],[7],[9]. From the pre-processing filter has been assessed on natural underwater images with and without additional synthetic underwater degradations as proposed in [2]. Underwater perturbations we added are typical perturbations observed and it has been tested with varying degrees of severity. We simulate blur and unequal illumination using Jaffe and McGlamery’s model [8], [10].Gaussian and particles noise as additive contributions to the images and finally reduced color range by histogram operation.

I. UNDERWATER IMAGE DENOISING

LeiFei and Wang Yingying have proposed proposes a de-noising method based on wavelet threshold and sub band enhancement method for image de-noising. The method proposed tries to improve the results, by removing the noise, improve the contrast, by maintaining the quality of image [11]. In order to achieve better de-noising effect, authors have suggested doing some pre-processing before wavelet threshold de-nosing [12], [13]. The pre-processing contains two steps, the first step, and use of Homomorphic filtering technology to eliminate the non-uniform illumination and balance contrast. This step reduces the illumination changes, sharpen the edge details, preserve details and minimize the noise in the image. The second step, apply Gaussian low-pass filtering for smoothing image [14]. The proposed algorithm combining adaptive threshold with adaptive output of the threshold function get a higher peak signal to noise ratio (PSNR). In addition, the method has achieved good visual effects and not only protect the image

detail information but also overcome the disadvantages of soft and hard threshold in a certain extent. It achieves good de-noising effect [15].

II. UNDERWATER IMAGE ENHANCEMENT

Image Enhancement is a method to improve the quality of a blurred image. Image gets distorted during the process of acquisition because of light intensity, angle of capture and Short comings of sensing device. Enhancement provides better input for automated image processing. A lot of efforts have been made to enhance low contrast images by improving various factors, such as enhancement of contrast, sharpening, denoising and improving the color accuracy [16], [17]. Pulung Nurtantio et al. [18] proposed a method for image enhancement using adaptive filtering base on CLAHE using Rayleigh Distribution [19].

1. **Contrast stretching:** Contrast stretching is a straightforward image enhancement method that is used to improve, enhance the image contrast by `stretching' the series of intensity values [20]. A measure of image's dynamic range or the "broaden" of image's histogram is the contrast of an image [36].

2. **Homomorphic filtering:** The homomorphic filtering is utilized to fix non-uniform lighting to reinforce contrast from the impression. This is a frequency filtering technique. It is the most utilized system on the grounds that it redresses non-uniform lighting and sharpens the picture.

3. **Anisotropic filtering:** Anisotropic filtering disentangles picture components to enhance picture division. This channel smoothes the picture in homogeneous range however conserve edges and upgrades them. It is utilized to smooth compositions and diminishes relics by erasing little edges enhanced by homomorphic filtering.

4. **Red channel method:** In this method, colors associated to short wavelengths are recovered, as expected for underwater images, leading to a recovery of the lost contrast [21]. The first thing in this method to estimate is the color of the water. Pick a pixel that lies at the maximum depth with respect to the camera. It is assumed that degradation of image depend upon location of pixel. After estimating the water light transmission of the scene is estimated. Then Color correction is done.

5. **Histogram equalization:** Histogram equalization is a method for modifying image intensities and contrast of image in image processing using the image's histogram. Histogram equalization is helpful in pictures with backgrounds and frontal areas that are both bright or both dim [22], [23],[24],[35][,37]. Sowmyashree et al. [8] have presented a relative study of the different image enhancement methods used for enhancing images of the bodies under the water. It also describes the various properties of water due to which the underwater images are distorted and degraded.

6. **Contrast Limited Adaptive Histogram Equalization (CLAHE):**

a) CLAHE on RGB color model

RGB color is an additive color model which depicts hues regarding the measure of red (R), green (G) and blue (B) present. It depicts what sort of light needs to be transmitted to create a given hues present in the image. CLAHE can be applicable to all the three parts i.e. Red, green and blue separately. The effect of full-color RGB can be acquired by combining the individual components of model [25], [26], [27].

b) CLAHE on HSV color model

HSV color model defines colors in terms of the Hue (H), Saturation (S), and Value (V). HSV color model is cylindrical-coordinate illustration of points in an RGB color model. This is the characteristic of a visual sensation as indicated by which a territory seems to be related to one of the color seen. The hue and saturation level don't have any kind of effect when value is at max or min intensity level. CLAHE is applied on V and S components.

7. **WCID (wavelength compensation and image dehazing):** WCID is an underwater image enhancement method or technique which compensate wavelength. As discussed above, two main causes of underwater image distortions are light scattering and color change. Sometimes artificial light source is used to overcome insufficient lightening problem. But it introduce additional luminance in the image.WCID is an only technique which handles problems of light scattering, color change and artificial light source presence simultaneously. This technique has a novel systematic approach to enhance underwater images by dehazing algorithm.

III. NOISE FILTERING

Filtering is a process of removing the noisy elements which are present in digital images which are horizontal to a variety of noise. Noise is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene. There are several ways that remove the noise which introduced in an image, depending on how the image is created. Such as blur effect, pepper noise etc[28].

There are various ways in terms of filters to remove these noise two of them are,

i. Removing noise through linear filter:

The linear filtering can be used to remove certain noise types. Some filters, for instance averaging or Gaussian filters, are suitable for this reason, e.g., an averaging filter is helpful for removing grain noise from a snap. As each pixel gets situate to the common of the pixels in its surrounding area, local changes caused by particle are compact.

ii. Removing noise through median filter:

Underwater image enhancement is also done with the help of one median filter [29] an efficient and low complexity underwater image enhancement method which contains two methods one is the Median filter which is used to approximation the transmission of input image. The atmospheric light A is obtained by using dark channel prior. Further upgrading a color correction quality is employed to enhance the color contrast of the object in underwater [30], [31]. Median filtering is similar to using an averaging filter, in that every output pixel is put to an average of the pixel values in the neighborhood of the corresponding input pixel. Though, by median filtering, the value of an output pixel is determined by the median of the region pixels, somewhat than the mean. The median is greatly less responsive than the mean to great

values. Median filtering is consequently well able to eliminate these outliers without declining the unevenness of the image [32].

IV. PROBLEM STATEMENT

This paper covers the image enhancement techniques and the image quality enhancement using filers, the atmospheric light is a major difficulty to process underwater images comes from the poor visibility conditions under the water, scattering of light and light attenuation due to all the reasons the underwater images suffers a lot and affect their visibility and the contrast which they contain actually. Light attenuation limits the visible distance, at about 20 meters in clear water and 5 meters or less in turbid or less muddy water.

Use of median filter which has proposed by Hung- Yu Yang, Pie-Yin Chen [33] which is used to estimate the transmission of input image the atmospheric light is obtained by using dark channel prior and used to remove the noise like pepper noise, with this method the noise can be removed and the image which has less amount of noise and more improved image can be achieved but the actual color contrast and less sharp image is less accurate than the original image therefore in future there is a need of some method in addition to improve the quality of these kind of underwater images.

V. CONCLUSION

In this paper different underwater image enhancement techniques are reviewed and studied. All the reviewed methods enhance the underwater images to great extent. We focused on a comparative analysis of different techniques of underwater image enhancement to enhance the quality of underwater images and different techniques used Color Stretching, USM filter, Contrast enhancement to enhance underwater images. The approached used i.e. median filter which is used to estimate the transmission of input image. The atmospheric light is obtained by using dark channel prior. Further improvement a color correction quality is employed to enhance the color contrast of the object in underwater and remove different noise particles.

REFERENCES

1. Bt. Shamsuddin, N.; bt. Wan Ahmad, W.F.; Baharudin, B.B.; Kushiro, M.; Rajuddin, M.; bt. Mohd, F., "Significance level of image enhancement techniques for underwater images," Computer & Information Science (ICCIS), 2012 International Conference on , vol.1, no., pp.490,494, 12-14 June 2012

2. Pooja sahu, Neelesh gupta, “a survey on underwater image enhancement techniques” 2014.

3. Chiang, J.Y.; Ying-Ching Chen, "Underwater Image Enhancement by Wavelength Compensation and Dehazing," Image Processing, IEEE Transactions on , vol.21, no.4, pp.1756,1769, April 2012

4. Shelda Mohan and T. R. Mahesh. "Particle Swarm Optimization based Contrast Limited enhancement for mammogram images." IEEE, 2013.

5. R. Sathya, M. Bharathi and G. Dhivyasri, “Underwater Image Enhancement by Dark Channel Prior”, IEEE sponsored 2nd International Conference on Electronics and Communication System (ICECS), 2015.

6. Adrian Galdran, David Pardo, Artzai Picón and Aitor Alvarez-Gila” Automatic Red-Channel underwater image restoration” Elsevier, 2014.

7. John Y. Chiang and Ying-Ching Chen. “Underwater Image Enhancement by Wavelength Compensation and Dehazing”IEEE, 2012.

8. Neethu M. Sasi and V. K. Jayasree. “Contrast Limited Adaptive Histogram Equalization for Qualitative Enhancement of Myocardial Perfusion Images” Scientific research, 2013.

9. H. Yang, P. Chen, C. Huang, Y. Zhuang and Y. Shiau, “Low complexity underwater image enhancement based on dark channel prior,” IBICA, pp.17-20, 2011

10. Muhammad Suzuri Hitam, Wan Nural Jawahir Hj Wan Yussof, Ezmahamrul Afreen Awalludin, Zainuddin Bachok, “Mixture Contrast Limited Adaptive Histogram Equalization for Underwater Image Enhancement”, 2013.

11. Harish, M.R.Gowtham “The Component Median Filter for Noise Removal in Digital Images” International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue5- May 2013.

12. Corchs, Silvia and Schettini, Raimondo, Underwater Image Processing: State of the Art hof Restoration and Image Enhancement Methods, EURASIP Journal on Advances in Signal Processing ,Milan, Italy,2010, 2010:1-14

13. Guangxiang Zhou, dandan Yang, A lifting wavelet de-noising method based on adaptive threshold, Journal of Guilin University of Electronic Technology, 2012, 32(2):150-153.

14. Puran Gour, Balvant Singh Rajesh Kumar Rai, "Underwater Image Segmentation using CLAHE Enhancement and Thresholding," *International Journal of Emerging Technology and Advanced Engineering*, vol.2, no. 1, January 2012.

15. Schechter, y and karpel, n., "clear underwater vision". Proceedings of the IEEE cvpr, 2011.

16. S.S. Bedi, Rati Khandelwal," Various Image Enhancement Techniques- A Critical Review", International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue3, March 2013.

17. Cheenu Sharm, Manshi Shukla ,"Methods for Image Enhancement: A review", International Journal of Computer Science and Mobile Computing, ISSN 2320–088X, Vol. 3, Issue. 8, August 2014, pg.602– 606.

18. Pulung nurtantio, "Underwater image enhancement using adaptive filtering for enhanced sift-based image matching, 2013.

19. Puran Gour, Balvant Singh Rajesh Kumar Rai, "Underwater Image Segmentation using CLAHE Enhancement and Thresholding," *International Journal of Emerging Technology and Advanced Engineering*, vol. 2, no. 1, January 2012.

20. Shyam Lal1 and Mahesh Chandra2, "Efficient Algorithm for Contrast Enhancement Of Natural Images" The International Arab Journal of Information Technology, Vol. 11, No. 1, January 2014

21. Adrian Galdran, David Pardo, Artzai Picón and Aitor Alvarez-Gila" Automatic Red-Channel underwater image restoration" Elsevier, 2014.

22. Neethu M. Sasi and V. K. Jayasree. "Contrast Limited Adaptive Histogram Equalization for Qualitative Enhancement of Myocardial Perfusion Images" Scientific research, 2013.

23. N. Senthilkumaran, J. Thimmiaraja, Histogram equalization for image enhancement using brain images, in: Computing and Communication Technologies (WCCCT),2014 World Congress on, IEEE, pp. 80–83,2014.

24. Yussof, W.N.J.H.W., Awalludin and E.A., Bachok, "Mixture contrast limited adaptive histogram equalization for underwater image enhancement," Computer Applications Technology (ICCAT), 2013

25. Andono, Pulung Nurtantio, I. PURNAMA, and Mochamad Hariadi. "Underwater image enhancement using adaptive filtering for enhanced sift-based image matching." Journal of Theoretical & Applied Information Technology 52.3 (2013).

26. Khan, Mohd Farhan, Ekram Khan, and Z. A. Abbasi. “Multi segment histogram equalization for brightness preserving contrast enhancement.”Springer Berlin Heidelberg, 2012.

27. Chang, Yung Tseng, Jen Tse Wang, Wang Hsai Yang, and Xiang Wei Chen. "Contrast Enhancement in Palm Bone Image Using Quad-Histogram Equalization."IEEE, 2014.

28. Gaurav Mangla, Sukhjinder Singh “Designing of ESF filter for underwater image enhancement” *International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 9, September 2015.*

29. Harish, M.R.Gowtham “The Component Median Filter for Noise Removal in Digital Images” International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue5- May 2013

30. T.A.Nodes and N.C.Gallagher, Jr.,” Median Filters: Some Manipulations and Their Properties,”IEEE Trans. Acoustics, Speech, and Signal Processing.

31. “Digital image processing” by Rafael C.Gonzalez and Richard E.Woods.

32. Huimin Lu, Seiichi Serikawa “UNDERWATER SCENE ENHANCEMENT USING WEIGHTED GUIDED MEDIAN FILTER” vol.22, no.12, pp.4841-4852, 2013.

33. Puran Gour, Balvant Singh Rajesh Kumar Rai, "Underwater Image Segmentation using CLAHE Enhancement and Thresholding," *International Journal of Emerging Technology and Advanced Engineering*, vol.2, no. 1, January 2012.

34. A. K. John, O. O. Williams: Employing Fuzzy histogram equalization to compute illumination invariance in face recognition system, I. J. intelligent System and application, pp. 54-60 (2012).

35. Eunsung Lee, SangjinKim, Wonseok Kang, Doochun Seo, and JoonkiPaik, “Contrast Enhancement Using Dominant Brightness Level Analysis and Adaptive Intensity Transformation for Remote Sensing Images”, VOL.10, NO.1, JANUARY2013.

36. K. Zuiderveld, "Contrast Limited Adaptive HistogramEqualization", Graphics Gems IV, pp. 474-485