Available online at www.elixirpublishers.com (Elixir International Journal)

Digital Processing

Elixir Digital Processing 94 (2016) 40471-40472

ISSN: 2229-712X

Evaluation of Underwater Image Haze Removal Techniques

Sonali Talwar[1] and Rajesh Kochher[2]

[1]Department of Computer Science Engineering, DAVIET, Jalandhar, Punjab, India.

[2]Department of Information Technology, Jalandhar, India.

ARTICLE INFO

Article history:

Received: 24 May 2015;
Received in revised form: 16 May 2016;
Accepted: 21 May 2016;

Keywords

Haze removal,
Underwater image dehazing.

ABSTRACT

Underwater images have a wide range of applications in different fields. But underwater images have poor visibility, low contrast and diminishing colors. These all problems erupt as a result of the haze present in underwater images which seriously lowers the quality of underwater images. So, underwater image dehazing or haze removal is important. Haze removal is a challenging and complex problem because it is based on unknown depth information. This paper has reviewed various techniques for haze removal in underwater images. Every technique has its own advantages and limitations. This paper has also discussed the methods, advantages and limitations of various underwater image haze removal techniques.

Introduction

Underwater Imaging is a very important research area in ocean engineering. Underwater images are captured to explore underwater world, perform underwater Surveys, Archaeology, Weather Forecasting, scuba diving and underwater aquatic life etc. Underwater haze removal techniques become very popular due to the use of various vision underwater applications. Exploring, understanding and investigating underwater activities of images are gaining importance. Scientists are keen to explore mystifying underwater world. But underwater images have poor visibility and low contrast due to haze. Haze is natural phenomenon which hinders the quality of underwater images. Haze removal is a challenging and complex problem because it is based on unknown depth information. Haze degrades the scene contrast and result in fading of colours. So, removing the haze is a complex and challenging task. Figure 1 shows a hazy underwater image. Various techniques have been proposed to remove the haze from underwater images and enhance the quality of underwater images. Some of them are discussed further.

Figure 1. Hazy Underwater image

Related work

Y.Y. Schechner and N. Karpel(2005)[1]The authors analyzed the physical effects of visibility degradation. It was that the main degradation effects can be associated with partial polarization of light. This paper proposed an image recovery algorithm based on a couple of images taken at different orientations with a polarizer .Distance map of the scene was also derived. It resulted into improvement of scene contrast and color correction and underwater visibility range was nearly doubled. K. Iqbal, R. Abdul Salam, M. Osman & A. Z. Talib (2007)[2] The authors presented an underwater image enhancement method using an integrated color model. They proposed an approach based on slide stretching: first, contrast stretching of RGB algorithm is used to equalize the color contrast in the images. Second, saturation and intensity stretching of HSI is applied to increase the true color and solve the problem of lighting. The blue color component in the image is controlled by the saturation and intensity to create the range from pale blue to deep blue. The contrast ratio is therefore controlled by decreasing or increasing its value. H.Y. Yang, P.Y. Chen, C.C. Huang, Y.Z. Zhuang & H.Y. Shiau (2011)[3] The authors proposed an efficient and low complexity underwater image enhancement method based on dark channel prior. In the proposed approach to estimate the depth map of image median filter had been used instead of the soft matting procedure. A color correction method was adopted to enhance the color contrast for underwater image. The presented approach required less computing time, enhanced underwater image effectively and was suitable for implementing on the surveillance and underwater navigation in real time. A.T. Çelebi & S. Ertürk (2012) [4]In this paper, the authors proposed Empirical Mode Decomposition based underwater image enhancement approach. The enhanced image was constructed by combining the IMF's Intrinsic Mode Functions of spectral channels with different weights in order to obtain an enhanced image with increased quality. Genetic algorithm was used to perform. The weight estimation automatically. The proposed approach provided better interpretability, visibility and perception of objects in the images. The enhanced images had more visual details, better quality and good contrast. J.Y. Chiang and Y.C Chen(2012)[5]In this paper, the authors proposed a novel algorithm called Wavelength Compensation and Dehazing to enhance underwater images. The dehazing algorithm used to compensate the attenuation discrepancy along the propagation path and to take the influence of the possible presence of an artificial light source

Tele:
E-mail address: sonalitalwar91@yahoo.com

into consideration. Firstly depth map was estimated and then the segmentation of foreground and background within a scene was done. The light intensities of foreground and background were compared to determine whether an artificial light source was 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 were corrected. Next, the water depth in the image scene was estimated based on 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 was conducted to restore color balance. The proposed approach in this paper significantly enhanced the visibility and shown superior color fidelity in the images. H. Wen, Y. Tian, T. Huang, & W. Gao.(2013)[6]In this paper, the authors derived an underwater optical model to describe formation of underwater image in true physical process and then proposed effective enhancement algorithm with derived optical model to improve perception of underwater images or video frames. M.S. Hitam, W. N. J. H. W. Yussof, E.A. Awalludin & Z. Bachok (2013) [7] presented method to boost underwater images utilizing a mixture Contrast Limited Adaptive Histogram Equalization. The enhancement method effectively improves the visibility of underwater images and produces the best MSE and the best PSNR values. CLAHE was applied to the image in RGB and Hue-Saturation-Value (HSV) color models separately. Here, the pixel distribution was set according to the Rayleigh distribution for the CLAHE process in both color models. These processes of applying CLAHE in the RGB and HSV color models produced two independent images: called CLAHE-RGB and CLAHE-HSV. These images were integrated to produce a contrast-enhanced image with low noise using Euclidean norm. S. Serikawa and H. Lu(2014)[8]Joint Trilateral filter is used for underwater image dehazing. In this paper, the authors presented a novel method for enhancing underwater images by image dehazing. A new underwater model had also been proposed to compensate the attenuation discrepancy along the propagation path. The proposed underwater model was suitable in underwater environment. They also proposed a fast joint trilateral filter for underwater image dehazing. The joint trilateral filter removed overly dark fields of underwater images by refining transmission depth map. The proposed joint trilateral filter also acted as edge preserving smoothing operator which had better behavior near the edges. The joint trilateral filter had fast and non-approximate constant time algorithm whose computational complexity is independent of filtering kernel size. The enhanced images were characterized by reduced noise level, improved quality, finest details and edges are enhanced, better exposedness of dark regions. Limitations are: The enhanced images by Joint Trilateral Filter may look dark and need contrast enhancement and Effect of artificial lighting source is not considered.

Gaps in Literature

1. The problem of uneven illumination is neglected by most of the haze removal techniques.
2. The image looks dark after haze removal.
3. Not much effort has been used to improve the contrast and colors of underwater images after haze removal.

Conclusion and Future Scope

Underwater image dehazing is a tough work but haze has to be eradicated because it degrades the scene quality. Various haze removal techniques are effective in removing the haze and enhancing the quality of underwater images. This paper has reviewed various underwater image dehazing techniques. This paper has also discussed the methods, advantages and limitations of various underwater image haze removal techniques.

References

[1] Y.Y. Schechner and N. Karpel “Recovery of underwater visibility and structure by polarization analysis.” IEEE Journal of Oceanic Engineering, 30, no. 3, pp.570–587, 2005.

[2] K. Iqbal, R. Abdul Salam, M. Osman & A. Z. Talib “Underwater Image Enhancement Using An Integrated Colour Model.” IAENG International Journal of Computer Science, 32, no. 2, pp. 239-244, 2007.

[3] H.Y. Yang, P.Y. Chen, C.C. Huang, Y.Z. Zhuang & H.Y. Shiau "Low complexity underwater image enhancement based on dark channel prior." IEEE Second International Conference on Innovations in Bio-inspired Computing and Applications, pp. 17-20, 2011.

[4] A.T. Çelebi & S. Ertürk “Visual enhancement of underwater images using Empirical Mode Decomposition.” Expert Systems with Applications (Elsevier), 39, no.1, pp. 800-805, 2012.

[5] J.Y. Chiang and Y.C Chen. "Underwater image enhancement by wavelength compensation and dehazing." IEEE Transactions on Image Processing, 21, no. 4, pp. 1756-1769, 2012.

[6] H. Wen, Y. Tian, T. Huang, & W. Gao "Single underwater image enhancement with a new optical model." In IEEE International Symposium on Circuits and Systems, pp. 753-756, 2013.

[7] M.S. Hitam, W. N. J. H. W. Yussof, E.A. Awalludin & Z. Bachok “Mixture contrast limited adaptive histogram equalization for underwater image enhancement.” In IEEE International Conference on Computer Applications Technology, pp. 1–5, 2013.

[8] S. Serikawa and H. Lu "Underwater image dehazing using joint trilateral filter." Computers & Electrical Engineering (Elsevier), 40, no. 1, pp. 41-50, 2014.