Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X
IMPACT FACTOR: 6.199

IJCSMC, Vol. 8, Issue. 4, April 2019, pg.69 – 72

Enhancing Underwater Image by Fusion

Pranit Patil[1]; Chaitnaya Patil[2]; Ujwal Patil[3]; Steffy D'mello[4]

[1]Computer Engineering, St. John College of Engineering and Management, India
[2]Computer Engineering, St. John College of Engineering and Management, India
[3]Computer Engineering, St. John College of Engineering and Management, India
[4]Computer Engineering, St. John College of Engineering and Management, India
[1] pranit1617@gmail.com; [2] chaitanyapatil189@gmail.com; [3] patilujwal1997@gmail.com; [4] dmellosteffy@gmail.com

Abstract— We introduce an efficient method to improve the quality of images which are captured underwater and images which are degraded by absorption and scattering of light. This method requires only one image that does not need any information about the underwater conditions or any specific type of hardware. The image is enhanced by reducing noise levels, better exposure of dark regions, enhanced global contrast and edges are enhanced significantly. It enhances the image by combining two images which are derived from the output of color enhancement and white-balancing result of the real image

Keywords— Underwater, Color enhancement, White balancing, Image fusion, Noise Reduction

I. INTRODUCTION

Underwater environment consists of various creatures such as marine animals and fishes along with one of a kind flora and fauna unlike that on the ground. In deep sea water we also find some shipwrecks and amazing undiscovered landscapes. Along with underwater imaging, underwater photography has been an interesting topic in different branches of scientific research and technology, such as inspection of underwater infrastructures and cables, detecting artificial objects, controlling underwater vehicles, marine biology research, and archaeology.

In Underwater conditions the image suffers from low visibility due to distraction of the propogating light, mainly from scattering effects and absorption. The absorption drastically reduces the light energy, while the scattered light causes changes in the light propagation direction. They result in contrast degradation and foggy appearance making the objects which are at a distance misty. Since, in common sea water images, the objects which are at a distance of more than 10 meters are almost unperceivable, and the colours are faded because their composing wavelengths are removed according to the water depth.

There have been various attempts to restore and enhance the visibility of such degraded images. Since the stagnation of underwater images results from the mixture of additive and multiplicative processes traditional image enhancement techniques such as histogram equalization, gamma correction appear to be sharply limiting for such a process.

Hence, the use of techniques such as white balance correction, colour balance, Gaussian pyramid and laplacian pyramid are used to colour correct and reconstruct the distorted images and also enhance the true colours of the image.

II. Our Enhancement Approach

In this paper we propose an single image based technique built on the principles of multi-scale fusion. We aim for a easier and efficient approach which is able to improve the visibility of a deep variation of the underwater images. Even though we are not following any specialized optical models, our framework blends specific weights and inputs carefully chosen in order to remove the restriction of such environments. Our method is generally applicable for underwater images decently enhancing the natural light. However, even when artificial lighting is needed, the influence of such components can be reduced easily by modifying the angle of the source light.

Our image enhancement strategy consists of four main steps: Saliency detection (detection of the focus points in the degraded image for improvement), White balance (add natural colours and increase the exposure of image), Gaussian and Laplacian pyramid (enhance contrast and removes blur from the image with final reconstruction of image) and multiscale fusion of the outputs of Laplacian and White balanced images.

A. Saliency Detection

Saliency is defined as the specific points in the image which the viewer eyes is most drawn to. These focus points in an image are difficult to measure but there are many eye tracking devices which can give us a sense of these focus points in the image and also the specific time for which the participant eyes are drawn to a particular spot. These points are the main points popping out of the image where the attention is at maximum level. These points are detected using Saliency weight. Saliency weight aims at enhancing the saliency object that lose their sharpness in deep seawater. To measure the saliency level, we have employed the saliency estimator of Achantay et al. [6]. This efficient algorithm is been inspired by using the concept of center surrounding contrast. The highlighted areas (regions with higher luminance values) are given more favor by these saliency maps. To overcome this, we are adding additional weight maps based on the observation that saturation is decreased in the highlighted areas.

B. White Balancing

White balance is a global adjustment of various intensities of different colours (typically blue, green and red primary colours). the main aim of white balancing is to render some of the specific colours, mainly the neutral colours properly. Hence, this method is sometimes generally called color balance, gray balance or white balancing. Colour balance improves the mixture of different colours in the image and is used to improve colour correction. White balancing adds more natural colour to the image and exposes the image. Generalized color balancing versions are used to correct colors. The illumination is judged by the value of *I* which is calculated from scene average *S* and parameter *P*.

$$I=0.5+S*P \qquad [1]$$

C. Gaussian and Laplacian

The main image is filtered multiple times and the sequence of reduced resolution images are generated. These contains a row of low pass filter copies of the main image in which the bandwidth is decreased in one octave step. This helps in removing the blury effect from the image. A Laplacian pyramid and the Gaussian pyramid are very much similar but the Gaussian pyramid saves the difference in the image which is the blurred versions of different image levels. Only the lowest level is not a different image so it is able to reconstruct on a high resolution image using the different images on the maximum level. The standard deviation light luminance of the region is given by

$$W_{LC}(x,y) = \|I^k - I^k_{\omega_{hc}}\| \qquad [1]$$

where WLC is the computed standard deviation, I^k is input luminance and I^k_{whc} is low passed luminance.

Original Image

White Balancing

Gaussian Pyramid

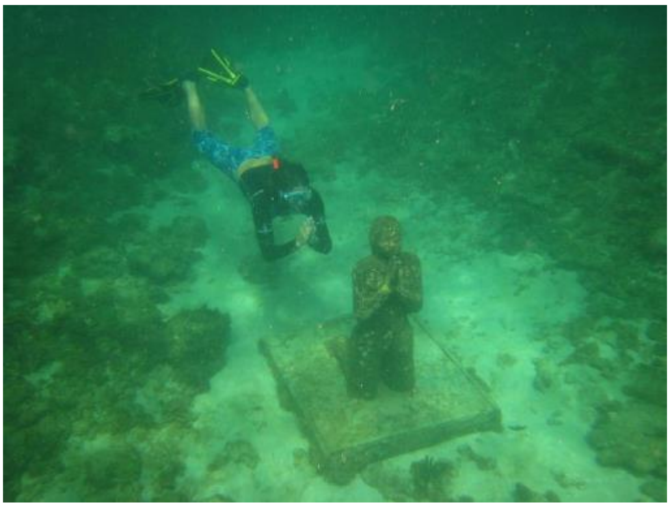
Laplacina Pyramid

Fig. 1 Blending Strategies

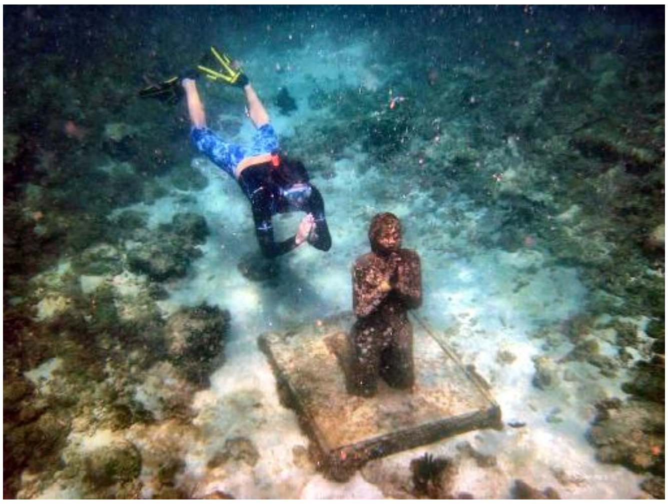
D. Multiscale Fusion Technique

From the different blending strategies we used to obtain the images, we fuse them to obtain the clear and enhanced underwater image. The main Gaussian image and Laplacian images are fused with multiscale fusion technique. The Laplacian multi-scale strategy performs relatively fast representing a good trade-off between speed and accuracy [2]. In order to control the threshold frequency, the standard deviation is increased singularly. To calculate the various levels of pyramid, initially we need to calculate the difference between Gaussian image and the original image. Further, the process of computing the difference of the two adjacent levels of Gaussian pyramid is carried out.

The Laplacian pyramids output image is a collection of quasi-bandpass version of the image. The Laplacian strategy of multi-scaling acts in a faster way representing a good balance between accuracy and speed. By independently applying the fusion process at each and every scale level the potential errors in the band filters and sharpness are significantly minimized. These two images of Laplacian pyramid and Gaussian pyramid together fuse to give output as a result. This output is a clear image with enhanced colours.



Original Image



Enhanced Image

Fig. 2 Before and After Image of Multiscale Fusion Technique

III. RESULTS AND DISCUSSION

This proposed technique was tested under real underwater conditions with different cameras. As after certain level of depth in water the cameras fail to do justice with the real world scenario of the nature including its texture and colours, this technique of enhancement using multi-scale fusion technique proves to be beneficial for the underwater photographers. It represents the real and true colour of the underwater world without distorting and dehazing the image. This technique even enhances the image upto an extent where our naked eyes struggle to find the details.

Our implementation doesn't demand very high end hardware and relies on the enhancement of the image via software. The professional cameras using RAW jpeg images and with 12 bit camera sensor were used to enhance the images while our method can process 8 bit images effortlessly. And this technique are resulting in giving more accurate results with improved global contrast, color and fine details while the temporal consistency of the images is well preserved.

IV. CONCLUSION

Even though the multi-scale fusion technique has its own limitations when capturing images deep down underwater where the light is not proper and the use of artificial light is still gives poor outcomes. But it surely overcomes all the limitations put by the hardware. Wherever the hardware fails, our technique compensates it limitation.

Our technique has a vision to minimize the requirement for hardware and special camera equipments to capture the beauty of underwater world. Using the present day technology we can get the spirit of the true colours of the underwater images. The multi-scale fusion technique can also be used to remove the limitations put by the hardware to capture underwater images.

REFERENCES

[1] Cosmin Ancuti, Codruta Orniana Ancuti, Tom Haber and Philippe Bekaert, "Enhancing Underwater Images and Videos by Fusion," IEEE 2012

[2] Pooja Sahu, Neelesh Gupta, Neetu Sharma, "A Survey on Underwater Image Enhancement Techniques" IJCA Volume 87-No.13,February 2014.

[3] Shivam S. Thakre, Amit Sahu, "Comparative Analysis of Various Underwater Image Enhancement Technique". IJCSMC, Vol. 3, Issue. 4, April 2014, pg.33 – 38.

[4] Bhanudas Sandbho, G. U. Kharat, "A Review on Underwater Image Enhancement Technique" . Volume 5, Issue 5, MAY 2015.pg .677-680.

[5] S. Bazeille, L. J. I. Quidu, and J. P. Malkasse. "Automatic underwater image pre-processing". In Proc. of CMM, 2006.

[6] R. Achantay, S. Hemamiz, F. Estraday, and S. Susstrunk, "Frequencytuned salient region detection," in Proc. IEEE CVPR, Jun. 2009, pp. 1597–1604.

[7] Chiang J Y and Chen Ying-Ching 2012 Underwater image enhancement by wavelength compensation and dehazing. IEEE Trans. Image Process. 21(4): 1756–176.

