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COLOR BALANCE AND FUSION FOR UNDERWATER IMAGE ENHANCEMENT

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Abstract: We introduce an effective technique to enhance the images captured underwater and degraded due to the medium scattering and absorption. Our method is a single image approach that does not require specialized hardware or knowledge about the underwater conditions or scene structure. It builds on the blending of two images that are directly derived from a color-compensated and white balanced version of the original degraded image. The two images to fusion, as well as their associated weight maps, are defined to promote the transfer of edges and color contrast to the output image. To avoid that the sharp weight map transitions create artifacts in the low frequency components of the reconstructed image, we also adapt a multiscale fusion strategy. Our extensive qualitative and quantitative evaluation reveals that our enhanced images and videos are characterized by better exposedness of the dark regions, improved global contrast, and edges sharpness. Our validation also proves that our algorithm is reasonably independent of the camera settings, and improves the accuracy of several image processing applications, such as image segmentation and key-point matching.

Index Terms - White Balancing, Gamma Correction, Sharpening, Multiscale Fusion, Laplacian weight, Saliency weight, Saturation weight.

I. INTRODUCTION

Underwater imaging is an important area in research and present technology. There are several rare attractions in underwater environment such as amazing landscapes, marine animals and mysterious shipwrecks. Scattering and absorption of light are the major reasons for low contrast and low clarity of underwater images. Absorption considerably reduces light energy and it depends upon many factors such as salinity and turbidity of water, number of suspended particles etc. Light scattering causes deflection of the ray from a straight path due to irregularities in the propagation medium, particles etc. They result in foggy appearance, low contrast and fading of colors. Also, image captured in underwater is hazy due to several effects of underwater medium. These effects are caused by the suspended particles in underwater. Water absorbs light wavelength to different degrees. Longer wavelengths get absorb in water first and shorter wavelength appear at a long distance. Water depth is highly correlated with color perception. The penetration of the visible spectrum colors depends on the depth of the water and wavelength. Disappearance of color in underwater occurs in the same order as they appear in the color spectrum and therefore it results in bluish tone of underwater images.

There are many strategies and methods for enhancing and restoring underwater images. Traditional enhancing techniques such as histogram equalization and gamma correction show strong limitations. It is also possible to enhance images using specialized hardware, wavelength compensation, wavelet strategy and dark channel de-hazing. These all strategies can enhance images but not much efficient for practicability due to some limitations.

Proposed method is an effective approach which is able to remove the haze and enhance image based on a single image captured with a conventional camera. It builds on the fusing of two images that are directly derived from color compensated and white-balanced version of the original degraded image. The white balancing [01] stage removes undesired color cast induced by underwater light scattering and produce natural appearance of underwater images. It reduces the quantization artifacts introduced by domain stretching. A well-known white balancing method Gray World algorithm is used which can achieve good visual performance for reasonably distorted underwater images. The reddish appearance of high intensity regions in the image is also well corrected since the red channel is better compensated.

Multi-scale implementation of fusion is an effective fusion based approach, relying on gamma correction and sharpening to deal with the hazy nature of the white balanced image. The weight maps such as laplacian contrast weight, saliency weight, saturation weight maps are used during blending in such a way that pixel with a high weight value are more represented in the final output image. It also can enhance the quality of the underwater images. The enhanced image after applying proposed method is given in Figure 1

Figure 1: degraded and enhanced underwater images

II. PROPOSED METHOD

The input image is taken/selected from the dataset and the pre-processing of the image is subject to white balancing and gamma correction and sharpening is done for the white balanced image later we apply different algorithms to get the normalized weights and later we perform Multiscale fusion to get the final enhanced image of the input image given.

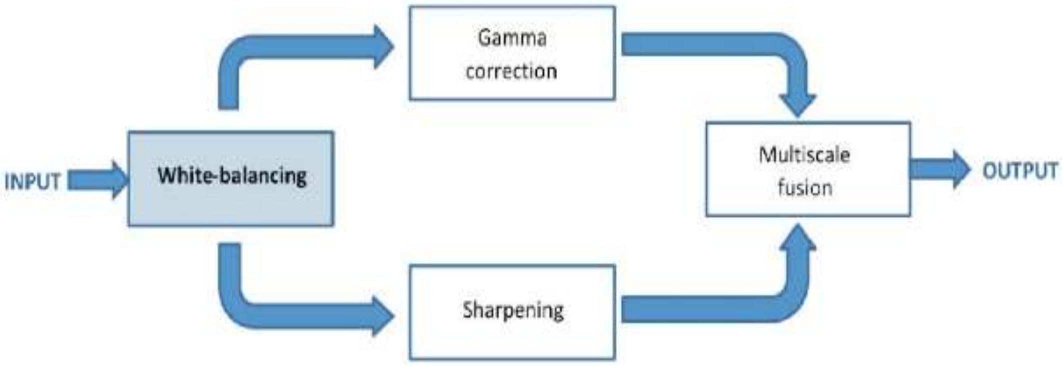

Figure 2: Block Diagram

2.1 White Balancing

White-balancing aims at improving the image aspect, primarily by removing the undesired color castings due to various illumination or medium attenuation properties. In underwater, the perception of color is highly correlated with the depth, and an important problem is the green-bluish appearance that needs to be rectified. As the light penetrates the water, the attenuation process affects selectively the wavelength spectrum, thus affecting the intensity and the appearance of a colored surface. Since the scattering attenuates more the long wavelengths than the short ones, the color perception is affected as we go down in deeper water. In practice, the attenuation and the loss of color also depends on the total distance between the observer and the scene.

Step 1: Compensation for the loss of the red channel

Step 2: Adoption of the Gray World algorithm to compute the white balanced image.

2.2 Laplacian contrast weight (WL)

It estimates the global contrast by computing the absolute value of a Laplacian filter applied on each input luminance channel [01]. However, for the underwater de-hazing task, this weight is not sufficient to recover the contrast, mainly because it cannot distinguish much between a ramp and flat regions. To handle this problem, we introduce an additional and complementary contrast assessment metric.

2.3 Saliency Weight (WS)

It aims at emphasizing the salient objects that lose their prominence in the underwater scene. To measure the saliency level, we have employed the saliency estimator [02]. This computationally efficient algorithm has been inspired by the biological concept of centre-surround contrast. However, the saliency map tends to favour highlighted areas (regions with high luminance values). To overcome this limitation, we introduce an additional weight map based on the observation that saturation decreases in the highlighted regions.

2.4 Saturation Weight (WSat)

It enables the fusion algorithm to adapt to chromatic information by advantaging highly saturated regions. This weight map is simply computed (for each input I_k) as the deviation (for every pixel location) between the R_k,G_k and B_k [03] color channels and the luminance L_k of the kth input:

$$W_{Sat} = \sqrt{\frac{1}{3}[(R_k - L_k)^2 + (G_k - L_k)^2 + (B_k - L_k)^2]}$$

2.5 Multiscale Fusion Process

The multi-scale decomposition is based on Laplacian pyramid originally described in Burt and Adelson. The pyramid representation decomposes an image into a sum of band pass images. In practice, each level of the pyramid does filter the input image using a low-pass Gaussian kernel G, and decimates the filtered image by a factor of 2 in both directions. It then subtracts from the input an up-sampled version of the low-pass image, thereby approximating the (inverse of the) Laplacian, and uses the decimated low-pass image as the input for the subsequent level of the pyramid. Formally, using Gal to denote a sequence of l low-pass filtering and decimation, followed by l up-sampling operations, we define the N levels L1 of the pyramid as follows:

$$\begin{aligned} I(x) &= I(x) - G1\{I(x)\} + G1\{I(x)\} \triangleq L1\{I(x)\} + G1\{I(x)\} \\ &= L1\{I(x)\} + G1\{I(x)\} - G2\{I(x)\} + G2\{I(x)\} \\ &= L1\{I(x)\} + L2\{I(x)\} + G2\{I(x)\} = \cdots = \textstyle\sum_{l=1}^{N} L_1\{I(x)\} \end{aligned}$$

In this equation, Ll and Gl represent the lth level of the Laplacian and Gaussian pyramid, respectively. To write the equation, all those images have been up-sampled to the original image dimension. However, in an efficient implementation, each level l of the pyramid is manipulated at native subsampled resolution. Following the traditional multi-scale fusion strategy [01], each source input Ik is decomposed into a Laplacian pyramid [04] while the normalized weight maps W¯ k are decomposed using a Gaussian pyramid. Both pyramids have the same number of levels, and the mixing of the Laplacian inputs with the Gaussian normalized weights is performed independently at each level l:

$$R1(x) = \sum G1\{\ K\ k{=}1\ W\bar{k}(x)\}\ L1\{Ik(x)\}$$

Where l denotes the pyramid levels and k refers to the number of input images. In practice, the number of levels N depends on the image size, and has a direct impact on the visual quality of the blended image. The de-hazed output is obtained by summing the fused contribution of all levels, after appropriate up sampling.

III. RESULTS

In this work we gone through process of single image dehazing which leads for image enhancement. To improve the quality of underground image there is need of some important steps to be followed. The result analysis is done using MATLAB 2016a software. Analysis is done by scripting the code in MATLAB and results proves that our method is better for different conditions of haze and underwater problems.

For the input image white balancing is applied at the first step, after that the output image is passed through gamma correction and edge sharpening. The output of gamma correction and edge sharpening are fused by multiscale fusion to get final enhanced image.

Figure 3: Input Image

Figure 4: White Balanced Image

Figure 5: Gamma Correction

Figure 6: Sharpened Image

Figure 7: Laplacian Image

Figure 8: Saliency Image

Figure 9: Saturation Image

Figure 10: Saliency detected 2nd Image

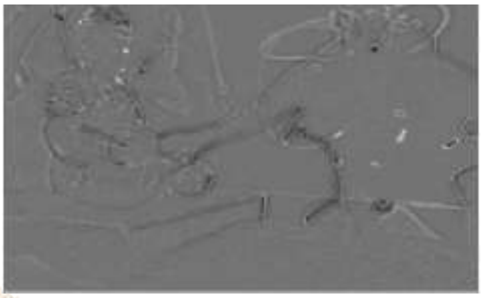

Figure 11: Normalized Weight applied Gamma Correction Image

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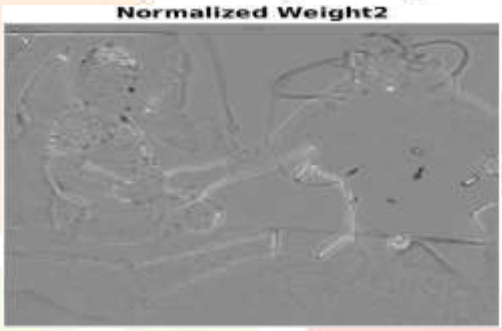

Figure 12: Normalized Weight applied at Sharpened Image

Figure 13: Fused Image

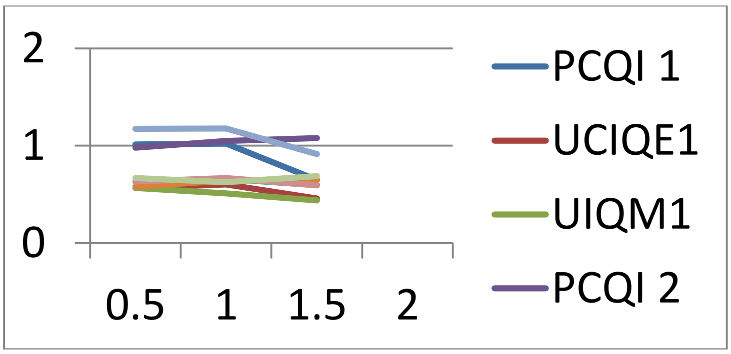

Figure 14: Comparison Results

Method	PCQI (He et al)	UCIQE (He et al)	UIQM (He et al)	PCQI (Ancuti)	UCIQE (Ancuti)	UIQM (Ancuti)	PCQI (White balance)	UCIQE (White balance)	UIQM (White balance)
Shipwreck	1.012	0.565	0.565	0.98	0.629	0.578	1.172	0.632	0.668
Fish	1.023	0.602	0.509	1.047	0.657	0.643	1.177	0.667	0.624
Image	0.649	0.456	0.437	1.077	0.595	0.651	0.914	0.592	0.687

Figure 14

IV. CONCLUSION

We have presented an alternative approach to enhance underwater videos and images. Our strategy builds on the fusion principle and does not require additional information than the single original image. We have shown in our experiments that our approach is able to enhance a wide range of underwater images (e.g. different cameras, depths, light conditions) with high accuracy, being able to recover important faded features and edges. Moreover, for the first time, we demonstrate the utility and relevance of the proposed image enhancement technique for several challenging underwater computer vision applications.

V. FUTURE SCOPE

Until now we have presented an alternative method only for underwater images, in future we can also try in presenting an alternative method for underwater videos as well.

VI. REFERENCES

[1] R. Schettini and S. Corchs, "Underwater image processing: state of the art of restoration and image enhancement methods," EURASIP J. Adv. Signal Process., vol. 2010, Dec. 2010, Art. no. 746052.

[2] T. Mertens, J. Kautz, and F. Van Reeth, "Exposure fusion: A simple and practical alternative to high dynamic range photography," Comput. Graph. Forum, vol. 28, no. 1, pp. 161–171, 2009.

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

[4] C. Ancuti, C. O. Ancuti, T. Haber, and P. Bekaert, "Enhancing underwater images and videos by fusion," in Proc. IEEE CVPR, Jun. 2012, pp. 81–88

[5] P. Burt and T. Adelson, "The laplacian pyramid as a compact image code," IEEE Trans. Commun., vol. COM-31, no. 4, pp. 532–540, Apr. 1983.