Underwater Image Enhancement

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Abstract- *Under water environment offers many rare attractions such as marine animals and fishes, amazing landscape, and mysterious shipwrecks. Besides underwater photography, underwater imaging has also been an important source of interest in different branches of technology and scientific research, such as inspection of underwater infrastructures. The underwater images degraded due to scattering and absorption. 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 promote the transfer of edges and color contrast to the output image. To avoid sharp weight map transitions that create artifacts in the low frequency components of the reconstructed image, we adapt a multiscale fusion strategy. our underwater dehazing technique consists in three main steps: input derivation from the white balanced underwater image, weight maps definition, and multi-scale fusion of the inputs and weight maps. Our experiments are Implemented and Simulated using MATLAB.*

Keywords- scattering, absorption, artifacts, dehazing.

I. INTRODUCTION

In the recent years the image processing techniques and methods has been improved to a greater extent. Very little research has been carried out to process underwater images. The existing research shows that underwater images raise new challenges and impose significant problems due to light absorption and scattering effects of the light and inherent structure less environment. People are much interested to explore the mysterious underwater world. However, the area is still lacking in image processing analysis techniques and methods that could be used to improve the quality of underwater images.

Underwater photogrammetry depends on clear water conditions and adequate lighting. Unfortunately, the color range decreases with increasing depth. The longer the frequencies, the more absorption occurs. Due to absorption, the water color often seems bluish. It estimates the mean water color automatically and corrects the images before the 3d reconstruction process is applied. Not only absorption has an influence on visual perception, but scattering is also an important factor. Depending on particle interaction, light energy will be redirected between the objects and the observer. To compensate for this effect, our software also improves image contrast.

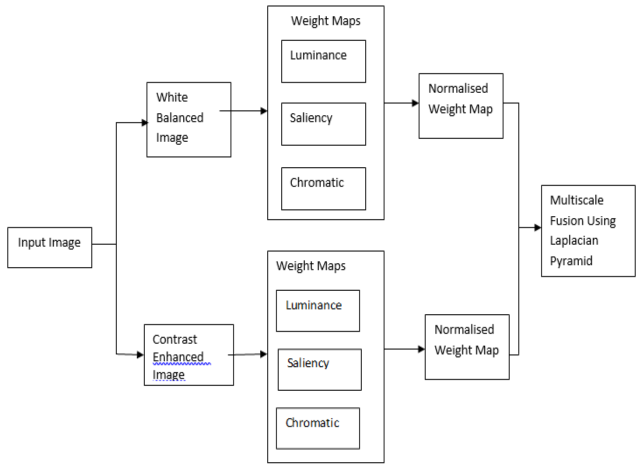

Fig. 1. Method overview: input image are derived as two images and find the weight map values and normalised. Using multiscale fusion to merge the output image.

Due to the absorption and scattering, the clarity and the observation of the depth of field of the image which is obtained by underwater photoelectric imaging will be reduced. This paper introduces a new single image enhancement approach based on image fusion strategy. The method first applies the white balance and global contrast enhancement technologies to the original image respectively, then taking these two adapted versions of the original image as inputs that are weighted by specific maps. We obtain the enhanced results by computing the weight sum of the two inputs in a per-pixel fashion. Since we do not employ deconvolution, the algorithm reduce the execution time and can effectively enhance the underwater image. In this paper, we prose an efficient and low complexity underwater image enhancement method. The proposed approach contains two mainly procedures, the direct reflection of the light from object and the reflection from the particles of the medium. Degradation of underwater images is different from normal images. In underwater imaging light interact with water in two ways, scattering and absorption. The scattering and absorption, together is called attenuation of light in water. This attenuation is wavelength dependent. Because of scattering and absorption, underwater images are affected by back scattering, forward scattering and absorption of light in water. As a result of which the images are degraded, and also dominated by green or blue color. Water is not only source of degradation, but underwater images are also affected by suspended particles and dissolved compounds in water. The degradation also depends upon depth of water, day time, geographical location, source of light and physical properties of water etc. many underwater application need clear underwater images. Image enhancement and restoration techniques is used for clearing the underwater images. The image enhancement are simpler and faster than restoration processes because it does not require any prior knowledge about the parameters of water, where image has been captured. This techniques includes contrast enhancement, non-uniform illumination correction, and color correction techniques. Among these very few researchers attempted a problem of non-uniform illumination correction. Some image enhancement and color correction techniques for underwater images reviewed in this paper. In underwater situations, clarity of images are degraded by light absorption and scattering. This causes one color to dominate the image. In order to improve the perception of underwater images, we proposed an approach based on slide stretching. The objective of this approach is twofold. Firstly, the contrast stretching of RGB algorithm is applied to equalize the color contrast in images. Secondly, the saturation and intensity stretching of HIS is used to increase the true color and solve the problem of lighting. Interactive software has been developed for underwater image enhancement. Results of the software are presented in this paper. In this paper, we have used slide stretching algorithm both on RGB and HIS color modes to enhance underwater images. In order to demonstrate the usefulness of our approach, we have developed an interaction software tool to be used for underwater image enhancement. First of all, it performs contrast stretching on RGB color model. Secondly, it performs saturation and intensity stretching on HIS color model. The advantage of applying two stretching models is that it helps to equalize the color contrast in the images and also addresses the problem of lighting.

II. WHITE BALANCING

In our approach, white balancing aims at compensating for the color cast caused by the selective absorption of colors with depth, while image fusion is considered to enhance the edges and details of the scene, to mitigate the loss of contrast resulting from backscattering. It 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 Penetrates the water, the attenuation

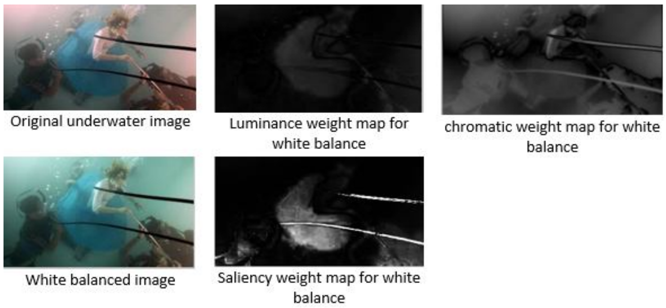

Fig. 2 Here the white balancing is done in underwater image. This will be calculated by the three weighmaps luminance, chromatic and saliency.

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. Our white-balancing approach reduces the quantization artifacts introduced by domain stretching (the red regions in the different outputs). The reddish appearance of high intensity regions is also well corrected since the red channels is better balanced.

1.) Laplacian contrast weight (wl)

Laplacian contrast weight (wl) estimate the global contrast by computing the absolute value of a Laplacian filter applied on each input luminance channel. This straight forward indicator was used in different applications such as tone mapping and extending depth of field since it assigns high values to edges and texture. For the underwater dehazing task, however, this weight is not sufficient to recover the contrast, mainly because it cannot distinguish much between a ramp and flat regions.

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

2.) Saliency weight (ws)

Saliency weight aims at emphasizing the salient objects that lose their prominence in the underwater scene. To measure the saliency level. This computationally efficient algorithm has been inspired by the biological concept of centre surround contrast. However, the saliency map based on the observation that saturation decreases I the highlighted regions. chromaticWeightmap = exp(-1 * (((saturationValue - saturationMax).^2) / (2*(sigma^2))));

3.) Saturation weight (wst)

Saturation weight enables the fusion algorithm to adapt to chromatic information by advantaging highly saturated regions. This weight map is simply computed (for each input IK) as the deviation (for every pixel
Location) between the Rk, Gk and bk color channels and the luminance Lk of the Kth input.

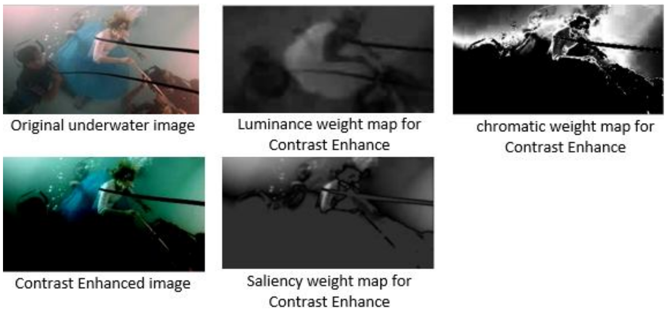

Fig. 3 here the contrast image is applied in the underwater image.

The weight maps also calculated by three weightmaps luminance, chromatic and saliency.

III. MULI-SCALE FUSION

In this work we on the multi-scale fusion principles to propose a single image underwater enhancement. Our framework builds on a set of inputs and weight maps derived from a single original image. In particular, as a pair of inputs is introduced to respectively enhance the color contrast and the edge sharpness of the white-balanced image, and the weight maps are defined to preserve the qualities and induced by the light propagation limitation in underwater medium. Inputs of the fusion process since the color correction is critical in underwater, we first apply our white balancing technique to the original image. This step aims at enhancing the image appearance by discarding unwanted color casts caused by various iluminants. In water deeper than 30ft, white balancing suffers from noticeable effects since the absorbed colors are difficult to be recovered. As a result, to obtain our first input we perform a gamma correction aims at correcting the global contrast and is relevant since, in general, white balanced underwater images tend to appear too bright. This correction increases the difference between darker/lighter regions. To compensate for this loss, we derive a second input that corresponds to a sharpened version of the white balanced image. The sharpening method defined is referred to as normalized un-sharp masking process in the following. It has the advantage to not require any parameter tuning, and appears to be effective in terms of sharpening. This second input primarily helps in reducing the degradation caused by scattering. Since the difference between white balanced image and its Gaussian filtered version is a high pass signal that approximates the opposite of Laplacian, this operation has the inconvenient to magnify the high-frequency noise, thereby generating undesired artifacts to the final

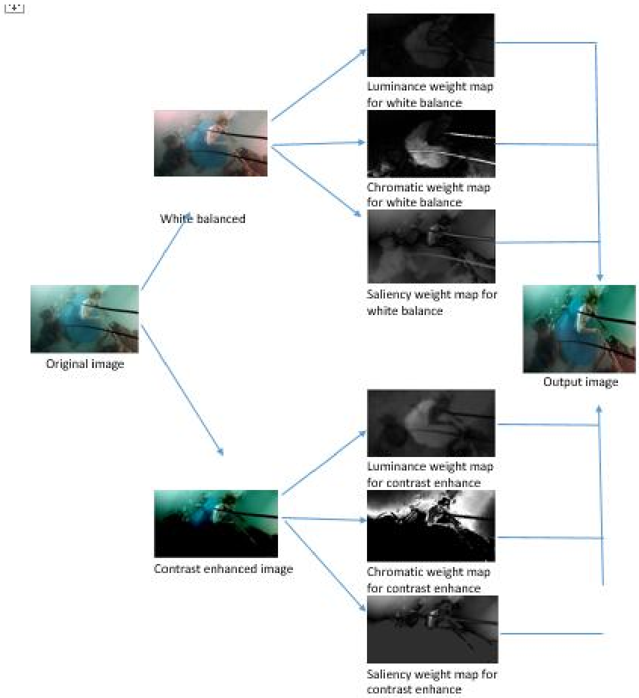

Fig. 4 Here the weight maps are calculated and normalized.

blended image. Weights of the fusion process the weight maps are used during blending in such a way that pixels with a high weight value are more represented in the final image. They are thus defined based on a number of local image quality or saliency metrics.

V. CONCLUSION

We have presented an approach to enhance underwater images. Our strategy builds on the fusion principle and does not require additional information than the original image. We have shown in our experiments that our approach is able to enhance a wide range of underwater images with high accuracy, being able to recover important faded features and edges.

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