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Underwater Image Enhancement using CLAHE

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ABSTRACT

In recent years, underwater images have been widely used in marine energy exploration, marine environment protection, marine military, marine life research and other fields. In these applications image acquisition is carried at varied depths of water, an artificial light is used to capture the underwater object. The physical properties of the water make light behave differently, changing the appearance of a same object with variations of depth, organic material, currents, temperature etc. This results in color distorted images and hazy images with very low contrast. Hence, there is a need to enhance the underwater images in light of the above applications.

Aim of this project is to enhance the underwater images which are affected by color distortion, contrast reduction and haziness. Initially, the original image is pre-processed by the white balance algorithm for color correction. White balance algorithm involves the process of removing unrealistic color casts in an underwater image. This colour corrected image is treated with dark channel prior dehazing method to obtain contrast enhancement. These two input images viz., i. Colour corrected and ii. Contrast enhanced are further processed by multiscale fusion strategy. Multiscale fusion strategy entails the restoration of image which is based on the weighted maps constructed by combining the features of global contrast, local contrast, saliency, and exposedness. Experimentation can be carried out on standard database RUIE of 400 images and U45 dataset to evaluate the performance of this approach in terms of mean square error, peak-signal-to-noise-ratio. The proposing methodology in this project can be utilized to enhance the underwater images by using MATLAB Software. Further these enhanced images can be used for various applications such as consumer underwater photography, marine life research, and underwater exploration.

INTRODUCTION

In earth 71% of its surface is covered with water and aquatic plants. There is more enthusiasm to known that what lies in underwater. Now a days an image of deep waters has a demand to large investigation to extent the underwater for sea floor exploration and navigation. The underwater imaging includes the inspection of seabed exploration and plants. And now the search for wrecks up and to the exploration of natural resources. Underwater images are essentially characterized by their poor visibility because light is exponentially attenuated as it travels in the water and the scenes result poorly contrasted and hazy. Due to above reasons, unmanned remote vehicles are use to sea floor explorations.

The quality of underwater images plays a pivotal role in ocean engineering and scientific research, such as monitoring sea life, accessing geological environment, and ocean rescue. However, the absorption and scattering effects of the water limit the visibility of the underwater objects. Consequently, the images captured by underwater cameras usually suffer from lowcontrast, no uniform illumination, blurring, bright artifacts, diminished color, noise, and other distortions. Many algorithms have been proposed for restoring colors and enhancing contrast for observed underwater images.

Light undergoes attenuation when it is passed through water. The larger wavelengths are affected more when compared to the shorter wavelengths, thus, images captured underwater appear greenish blue as they lack certain wavelength components extensively. For instance an image acquired at a depth of about 4-5m underwater will lack red wavelength because the longer wavelength components of the visible spectrum is attenuated first (Figure 1.1)

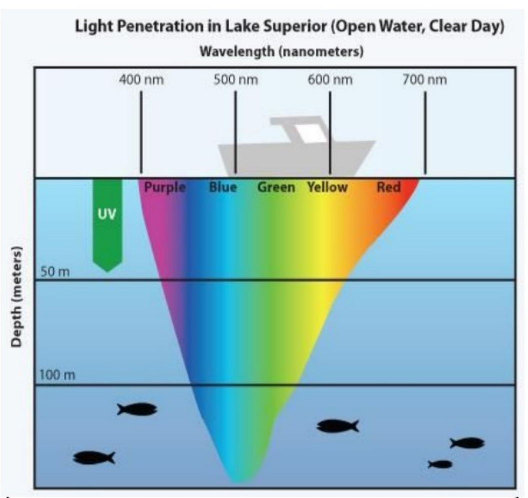
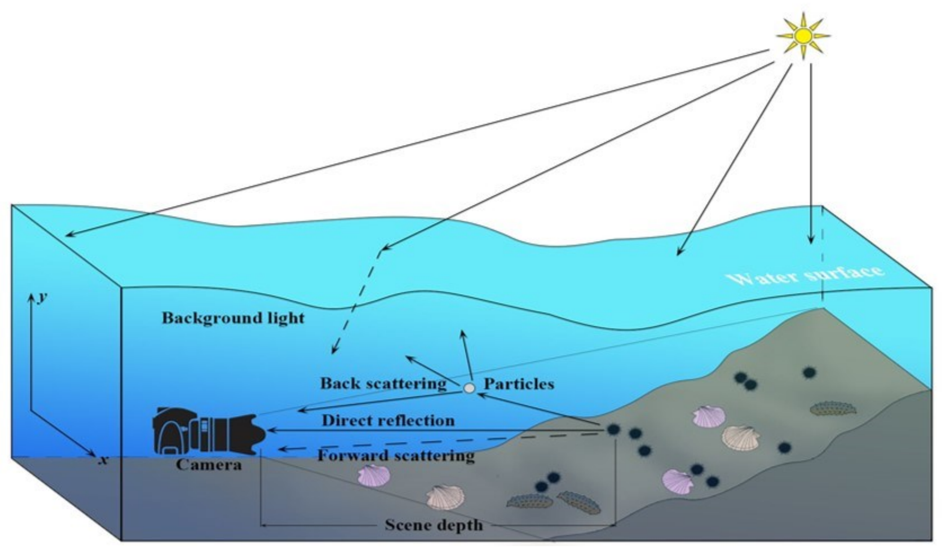


Figure 1.1—Attenuation of components of light with increasing depth underwater.



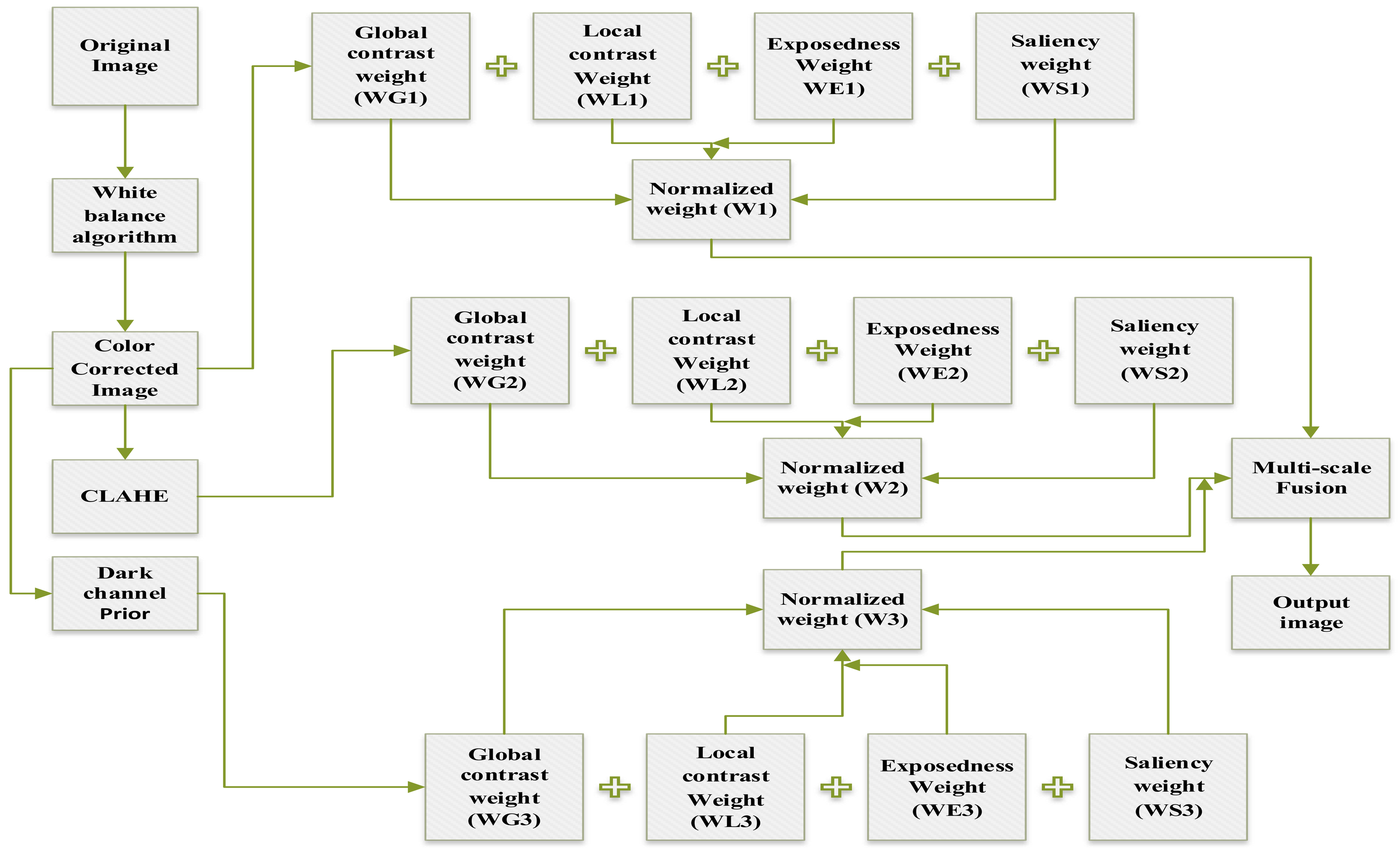
EXISTING METHODOLOGY

Underwater images suffer from blurring effects, low contrast, and grayed-out colors due to the absorption and scattering effects under the water. Few image enhancement algorithms have been developed for underwater images. Unfortunately, no well-accepted mechanism exists that can enhance the underwater images similar to human perception.

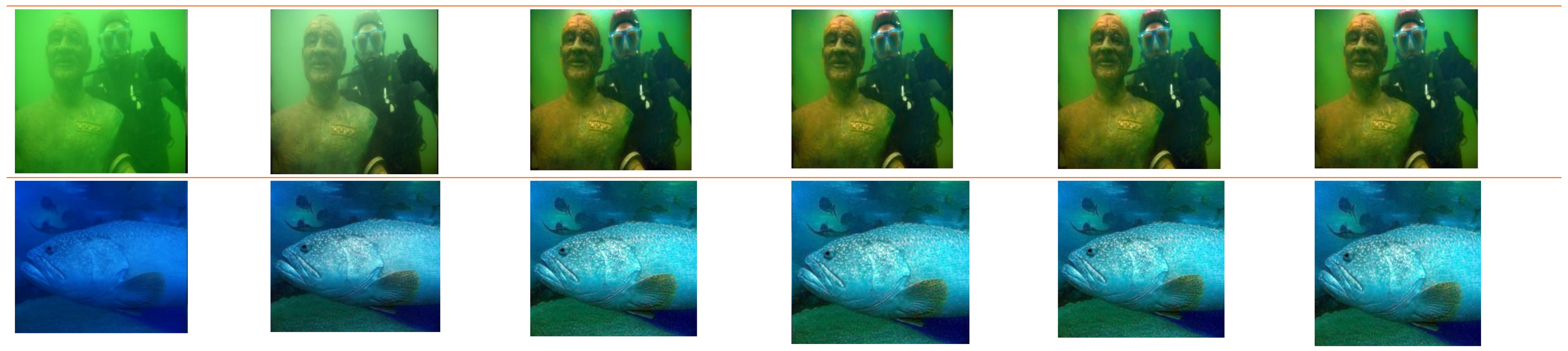
First, the first input image (input 1) is obtained by utilizing the WB algorithm to correct color from the original image and the second input image (input 2) is obtained by applying the DCP algorithm to input 1 to reduce the degradation due to particle scattering. Then calculate the global contrast weight, local contrast weight, saliency weight, and exposure weight of input 1 and input 2, respectively, and normalize the four weights of the two images to obtain the normalized weights W1 and W2. Finally, input 1 and input 2 are fused according to normalized weights W1 and W2. To avoid undesirable halos in the output image caused by edge mutation, a multiscale fusion strategy is adopted.

PROPOSED METHODOLOGY

The flow chart of the proposed approach implementation is shown in Figure(4.1). The proposed approach is composed of three parts, that input images, calculate the weight of input images, and multiscale fusion. First, the first input image (input 1) is obtained by utilizing the WB algorithm to correct the color from the original image, and the second input image (input 2) is obtained by applying the DCP algorithm to input 1 to reduce the degradation due to particle scattering. The third input is obtained by passing it to CLAHE. proposed approach is composed of three parts, that input images, calculate the weight of input images, and multiscale fusion. First, the first input image (input 1) is obtained by utilizing the WB algorithm to correct the color from the original image, and the second input image (input 2) is obtained by applying the DCP algorithm to input 1 to reduce the degradation due to particle scattering. The third input is obtained by passing it to CLAHE. In our fusion strategy, a well-designed input image is a key to obtaining a high-quality output image. As shown in Figure, the first derived input image (input 1) processed by the WB algorithm is obtained to correct the color deviation of the original image, while the second (input 2) processed by the DCP dehazing and CLAHE (input 3) algorithm is computed to enhance contrast and sharpness of input 1.



SIMULATIONS AND RESULTS



Original Image | White Balancing | Color Correction | DCP | CLAHE | Output Image

CONCLUSIONS

We proposed a new method to enhance the underwater images, by using the CLAHE algorithm in this project to achieve better contrast in images. We used MSE, PSNR, SSIM, UICM, UISM, UIConM, UIQM, and UICQE metrics to measure image contrast. This approach has successfully corrected the color cast and removed the haze of the underwater image, based on the qualitative results obtained.

REFERENCES

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