Integration of Enhanced Background Filtering and Wavelet Fusion for High Visibility and Detection Rate of Deep Sea Underwater Image of Underwater Vehicle

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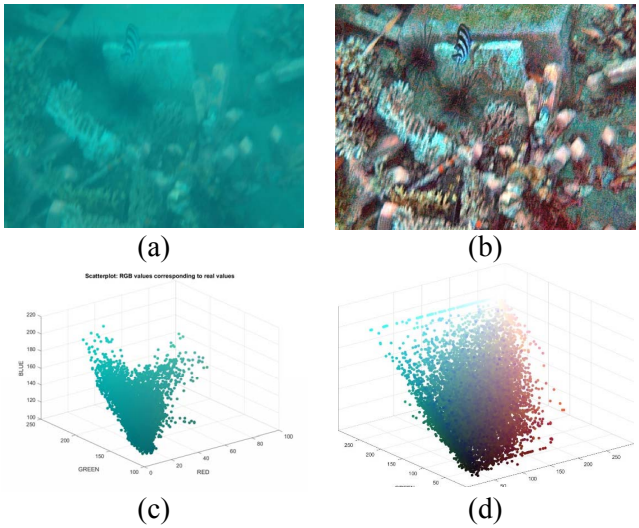
***Abstract*— This paper presents an enhanced technique for contrast and visibility improvement for deep sea underwater image which is normally used for underwater robot. The proposed technique uses an integration approach of enhanced background filtering and wavelet fusion methods (EBFWF). The novelty lies in this case in its methodology and capability of the proposed approach to minimize negative underwater effects such as blue and green color casts, low contrast, and low visibility in comparison with other state-of-the-art methods. The proposed method consists of a few steps that aims to eliminate negative effects and thus improving the contrast and visibility of underwater image. This purpose is carried out to provide a better platform for object detection and recognition processes. The input image is first sharpen before the low frequency background is removed. This minimizes the probability of image data to be regarded as noise in the consequences processes' steps. Image histograms are then mapped based on the intermediate color channel to reduce the gap between the inferior and dominant color channels. Wavelet fusion is applied followed by adaptive local histogram specification process. Based on the conduced tests, the proposed EBFWF technique, computationally, more effective and significant in improving the overall underwater image quality. The resultant images processed through the proposed approach could be further used for detection and recognition to extract more valuable information.**

Keywords*— *underwater image; background filtering; wavelet fusion; reference histogram mapping; adaptive local histogram specification.

I. INTRODUCTION

The important of underwater image enhancement has gradually known by most of the researchers. This could be seen by increasing number of researches done by researchers. Underwater image, mainly due to insufficient lighting in water medium, affected by several problems such as low contrast, blue-green color cast, and low visibility. Water medium filters light spectrum from the light source based on the wavelength, beginning from the longest wavelength. In addition, light that incident on the water surface will be partially reflected back and some portion will travel through the water medium. Based on the principle of energy level, red color channel which is the longest wavelength, possesses the lowest energy level, followed by green and blue color channels. Thus, red spectrum color will be first absorbed followed by green and blue. This effect results in greenish and bluish color of captured underwater environment.

Image enhancement technique, especially for underwater image, is required mostly for better visualization or rendering of images in order to help human visual perception [1]. For instance, underwater image in Fig. 1(a) is covered by blue-green illumination as consequences of low amount of light source (Fig. 1(c)). Based on the calculation, the ratio of the color channel R: G: B is 4.97: 48.14: 46.89. Red color is the inferior color channel as compared to green and blue color channels. Objects in original image are hardly identified, thus, reduce the image details and the capability of object detection. Based on 3D color representation (Fig. 1(d)), enhanced image (Fig. 1(b)) has scattered and wider pixel distribution as compared to original image. Therefore, the proposed EBFWF method is designed to address these problems as pre-processing step in image processing and provides a better platform in extracting information from such image.



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