UNDER WATER COLOR IMAGE ENHANCEMENT USING MULTI SCALE IMAGE FUSION

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ABSTRACT: Owing to the refraction of light and absorption of wavelength of light with the aid of suspended particles in water, those characteristics can drastically interfere with the photograph visibility and recognization. We propose a multiscale image fusion enhancement approach to improve the underwater image quality. This approach is constructed on the fusion of two different inputs which might be obtained from dehazing and performing some operations by using the color space model. This proposed method is dedicated to improve the clear details of an image, intensity and adjust the color distribution. The directing features of the two inputs are to be included and integrated by using the pyramid fusion approach. The integrated inputs are finally boosted by proper enhancement. The evaluation of the proposed method can beautify the underwater image best in unique eventualities with higher visual appearance and also enhancing the detector performance of numerous underwater packages.

Key words— characteristics, image fusion, enhancement, performance

INTRODUCTION

The underwater world is an environment that accommodates of ocean, sea and so on. The unknown and extensive resources available underwater are to be explored and examined. Underwater surrounding is hostile to human beings in lots of methods and therefore it's far specifically little explored.

Specific from the natural optical imaging situations, capturing of an underwater photo is tough because as the range and intensity will increase, the energy of the mild absorption varies. The wavelength of the blue and green wavelength can travel longer distance due to higher frequency thus absorption of the light within the water provides us with bluish-green pix unlike that of an in-air image. The raw underwater pictures also are accompanied with blurred details due to refraction and scattering of the suspended particles in the water. Forward scattering and backward scattering, during the light transmission through the water, can be found that particularly contributes to blurriness and modifications in the direction of color, also due to the components present in the water bodies. The visibility of the picture can be extended through setting up professional underwater devices and synthetic lightning but nonetheless these systems are high priced and the scene might still be illuminated in non uniform style.

With the growth in the data and computing technology, numerous underwater vision recuperation technologies had been introduced which includes many kind of techniques to attain extra records retained underwater photos. In this paper, to triumph over some of the outcomes, we suggest an underwater image enhancement method by using the multiscale image fusion approach to extract the essential features from a couple of source images of the identical scene i.e. at a multiple scales of time of the same photo. We propose two techniques for the fusion input. One technique deals with image dehazing approach and the opposite technique offers with reimbursement of the channels compensation in the color space model. The distinct capabilities of the two strategies are fused with the unique weights and eventually the enhancement is fulfilled with a quality restoration end result.

RELATED WORK

In the previous couple of years, many strategies of underwater vision generation have been proposed to develop the underwater photo processing, focusing on the bodily scene facts recuperation and computing records.

Yuan et al. [1] proposed a model for enhancing the texture of underwater images which is based on a fusion of blurriness and color information. The results show a better visual quality image and quantitative metrics. Han et al. [2] proposed an effective method for removing haze from single images using the dark channel prior i.e. to estimate the haze thickness and to recover the clear image. The results show better haze removal performance in terms of both visual quality and objective metrics. Ancuti et al. [3] proposed a fundamental step called color channel compensation (3C) for image enhancement which compensates for differences in the color response of different image sensors or channels and normalizes the image color values. The results show that the 3C method significantly improves the performance of existing image enhancement algorithms. Yuan et al. [4] proposed an image enhancement algorithm for underwater images based on contour bougie morphology. The algorithm first extracts the edges of the image using a morphological gradient operator. Then, it applies morphological operations to enhance the edges and improve the overall contrast and sharpness of the image. This method is evaluated using both subjective and objective measures and shows significant improvement over existing methods. Ancuti et al. [5] proposed a fusion-based approach for enhancing underwater images and videos. This method first extracts the details of the input images or frames using laplacian pyramid decomposition. Then, it applies a fusion algorithm to combine the details of the input with a reference image or frame to produce the enhanced image or frame. The results show the improvement in the visibility and quality of underwater images and videos. Yang et al. [6] proposed a new metric for evaluating the quality of underwater color images. They developed a metric that takes into account the unique characteristics of underwater images, such as the effects of light scattering, absorption, and color distortion. This metric is based on a combination of color and texture features that are extracted from the image using a set of filters. Peng et al. [7] proposed a method for restoring underwater images using combination of blurriness and light absorption. This approach involves deblurring the image and color balance compensation for light absorption. The results show improvements in image quality.

Overall, the research in these papers present a promising new approach to underwater image enhancement, and such techniques that could have significant applications in areas such as marine biology, oceanography, and underwater archaeology.

METHODOLOGY

This section will feature the explanation for the implementation of steps involved in the combination of dehazing and color information of the image to improve its overall quality of underwater image.

Block Diagram:

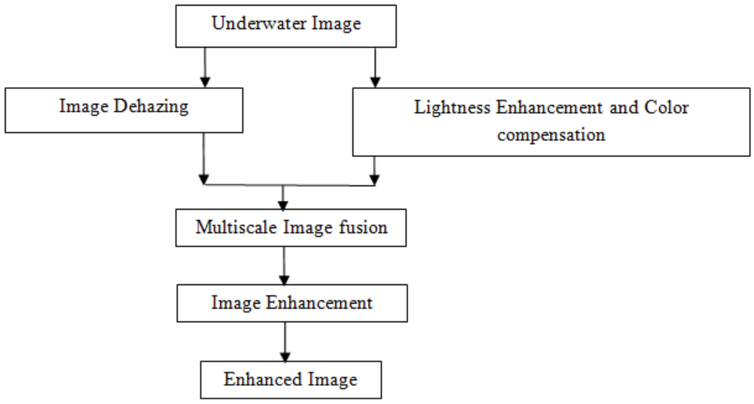


Fig. 1: Block diagram of underwater color image enhancement using multiscale image fusion.

To enrich the picture shells with top quality, two new combination inputs are predicated on various variety strategies. One input is employed to work on the sharpness of a picture. It's to settle the corruption caused by the light dispersing, and we apply the dehazing model to work on the face of the each encompassing scene. The alternate input is employed to upgrade the counter brilliance and change the variety rotation. The raw images are changed over from the RGB model into the YUV color model. The transformation of the variety model can kill the dispersion discrepancy among colors.

The steps involved are:

Step 1: Read in the input image which is an aquatic image.

Step 2: Calculate the dark channel of the input image using the sliding window approach.

Step 3: Calculate the atmospheric light value from the image.

Step 4: Estimate the transmission map of the image using the dark channel and atmospheric light value.

Step 5: Use guided filter to smooth the transmission map.

Step 6: Acquire the dehazed image by calculating the medium transmission map and also using it to remove the atmospheric veil from the input image.

Step 7: Convert the input RGB image to YUV color model.

Step 8: Perform some morphological operations on the Y channel of the input image to enhance the edges.

Step 9: Enhance the U and V channels of the input image using a Gaussian filter and a mask operation.

Step 10: Recombine the YUV channels to gain the enhanced color image and convert it back to an RGB color space.
Step 11: Evaluate weights for the aggregate blending, for both the dehazed image and the enhanced RGB color image.
Step 12: Generate Gaussian and Laplacian pyramids for both the dehazed image and the enhanced color image.
Step 13: Blend the pyramids to gain the final image.
Step 14: The final image is enhanced for further enhancement.

3.2 Experimental Setup:

Underwater color image quality evaluation (UCIQE) and underwater image quality measure (UIQM) are two different image quality assessment (IQA) metrics used to evaluate the quality of digital images.

a. Underwater color image quality evaluation (UCIQE):

UCIQE uses a combination of color constancy, contrast, and sharpness measures to produce a single quality score for an underwater image.

$UCIQE = 0.4680 * \sigma_c + 0.2745 * con_l + 0.2576 * \mu_s$ -[1]

where, σ_c is the standard deviation of chroma, con_l is the contrast of luminance and μ_s is the average of saturation with 0.4680, 0.2745 and 0.2576 as weighted coefficients.

b. Underwater image quality measure (UIQM):

UIQM is designed to be robust to variations in image content and quality which includes three submerged picture property gauges: UICM, UISM and the UIConM.

$UIQM = 0.0282 * uicm + 0.2953 * uism + 3.5753 * uiconm$ -[2]

UCIQE and UIQM measurements spotlight the strength of low-level elements of the picture. These two are consolidate straightly proportions of variety and sharpness.

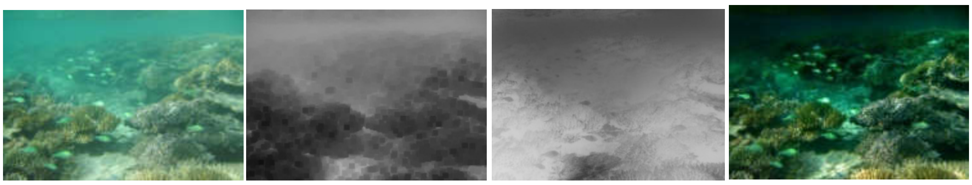
3.3 System Requirements:

User Interface:

- MATLAB R2017a version [tool for scientific computing, numerical solution and data analysis]
- Windows 11, RAM: 4GB (or more)

RESULTS AND DISCUSSION

Scope: The objective is enhancement of an underwater image by using the multiscale image fusion method that allows the users to obtain a more data retained underwater image.



(a) (b) (c) (d)

Fig. 2: Process of image dehazing approach. (a) Raw underwater image (b) Dark channel (c)Transmission estimate (d) Dehazed image

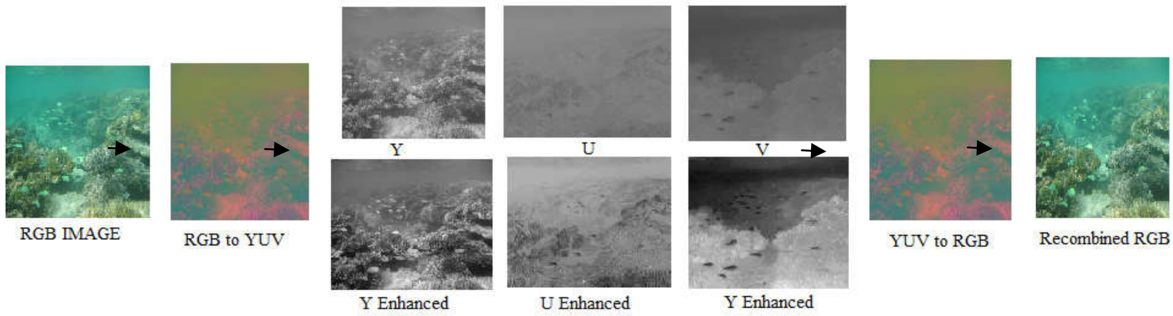


Fig. 3: Process of Y channel enhancement and U, V channels compensation and recombination of image.

(a) (b)

Fig. 4: Process of multiscale image fusion (a) Fused Image (b) Enhanced Image

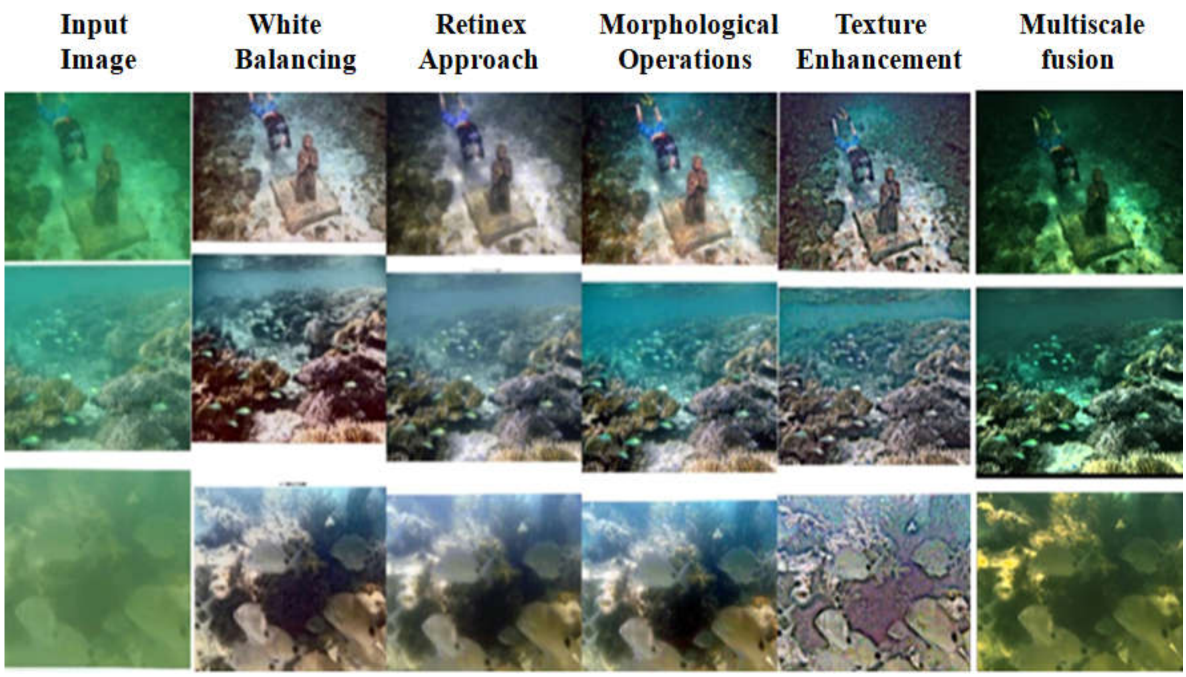


Fig. 5: Comparative Analysis with the existing methods and the proposed method

Table 1: UCIQE and UIQM metric values on four reference images

	IMG-1		IMG-2		IMG-3		IMG-4	
	UCIQE	UIQM	UCIQE	UIQM	UCIQE	UIQM	UCIQE	UIQM
Ancuti et al. [6]	0.2950	4.1901	**0.8595**	4.3086	0.0754	4.6677	0.4605	4.7503
Fu et al. [3]	0.6147	4.1961	0.6147	4.2001	0.5730	4.6181	0.6345	4.3360
Yuan et al. [5]	0.6532	3.6858	0.6364	3.5443	0.6442	4.5974	0.6512	3.6781
Yuan et al. [1]	0.5950	3.7603	0.6468	**4.7037**	0.6295	4.8010	0.6447	4.1091
UIEMIF	**0.9737**	**4.2005**	0.7928	4.1882	**0.9783**	**4.8196**	**0.8598**	**4.7882**

This paper proposed an underwater image enhancement based on the pyramid fusion method that processes on single image, which ensures the improvement of the color information and provide an effective visibility of a degraded image. The proposed method focuses on correcting the color and illumination of the image and fusion of these improved results together. This method generates improved quality images for all the test images. Table 1 clearly shows that the resultant images obtained from this method has higher UCIQE and UIQM values compared to previous existing methods which proves the robustness and effectiveness of this solution for enhancing different kinds of input underwater images.

CONCLUSION

We propose an image enhancement technique utilizing the multi-scale image fusion method that processes two data sources. The dehazing step can basically eliminate the fog in the foundation of the scene and improve the scene. The color model step can improve the dimness, splendor of the framework also, with the specific surfaces. Since the variety predisposition is successfully removed, the results protect a significantly stable variety tone. The combination of pyramids can actually unite the critical elements of two improved approaches without causing additional deviations. Overall, improving the combined image is a significant method that can further improve the visual quality and interpretation of the image. We can make it more helpful for various image analysis and decision-making tasks.

FUTURE SCOPE

The method used in this paper contributes to a single image enhancement that can also be stretched out for video processing. Additionally, with propels in deep-learning-based methods that show promising results, progresses in improving and recovering results can be introduced.

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