IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Special Issue-10, May 2019 E-ISSN: 2347-2693

An Optimal Underwater Colour Image Enhancement Using CAUF-MCAHE Technique

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DOI: https://doi.org/10.26438/ijcse/v7si10.187190 | Available online at: www.ijcseonline.org

Abstract— Underwater imaging posts a challenge due to the degradation by the absorption, scattering and color distortion occurred during light propagation & in poor lighting conditions in water medium. Many different image filtering techniques are utilized to improve image quality effectively. Images which are captured under water are generally degraded due to the effects of absorption and scattering. For example, underwater images with low contrast decrease the accuracy rate of underwater object detection and marine biology recognition. To overcome those limitations, a systematic underwater image enhancement method, which includes a contrast enhancement algorithm, is proposed. In this paper, we proposed an image based pre-processing technique i.e. CAUF-MCAHE algorithm to enhance the quality of the underwater images. Experiments are performed with some underwater images and results are compared with different existing algorithm. For comparing the performance, MSE mean square error and PSNR peak signal to noise ratio is used as parameters.

Keywords— *MCAHE (Modified Contrast adaptive histogram equalization), UF (unsharp filter), AHE (Adaptive histogram equalization), PSNR (Peak signal to noise ratio) & MSE (Mean square error).*

I. INTRODUCTION

Underwater image enhancement techniques are used to improve the object identification in underwater environment. Underwater environment image get blurred due to poor visibility conditions and effects like “absorption of light”, “reflection of light”, “bending of light, “denser”, and “scattering of light” etc [1]. The researchers have reviewed several techniques related to images enhancement viz “contrast stretching” “histogram equalization” “contrast limited adaptive histogram equalization (CLAHE)[2].

II. RELATED WORK

The main objective is to propose method in which underwater imaging model compensates for the attenuation discrepancy along the propagation path. The enhanced images are characterized by a reduced noised level, better exposure in dark regions, and improved contrast, by which the finest details and edges are enhanced significantly.

(i)INTERPOLATION METHODS: Interpolation works by using known data to estimate values at unknown points. Common interpolation techniques are nearest neighbor, bilinear and cubic convolution. Applications of image interpolation methods are image enlargement, image reduction, sub pixel image registration, image decomposition and to correct spatial distortions and many more [7].

(ii)HISTOGRAM EQUALIZATION: Histogram equalization is a method for modifying image intensities and contrast of image in image processing using the image's histogram. Histogram equalization is helpful in pictures with backgrounds and frontal areas that are both bright or both dim [8].

(iii)ADAPTIVE HISTOGRAM EQUALIZATION: The AHE process can be understood in different ways. In one perspective the histogram of gray levels (GL’s) in the output is maximally black; if it has the median value in its window the output is 50% gray’s window around each pixel is generated first.

(iv)UNSHARP FILTER: Digital unsharp masking is a flexible and powerful way to increase sharpness, particularly in scanned images. On the other hand, these effects could be used creatively, mainly if a single channel of an RGB or Lab image is sharpened. Unwanted or Undesired effects can be reduced by using a mask – particularly one created by edge

detection – to only apply sharpening to desired regions, sometimes termed "smart sharpen" [6].

(v)CAHE (COLOR ADAPTIVE HISTOGRAM EQUALIZATION) ALGORITHM: In this color image adaptive histogram equalization algorithm first to transform the color image to an alternative, perceptual color model such as HSV, in which the luminance component (intensity V) is decoupled from the chromatics (H & S) components which are responsible for the subjective impression of color [7].

III. METHODOLOGY

The proposed method algorithm can be better understood by the following flowchart. We are starting with any color underwater image and then different interpolation methods are applied on an original color image like nearest neighbor method; bilinear method and bicubic method. The method with best PSNR is identified as bilinear interpolation method. Firstly convert the bilinear interploated RGB image into YcbCr component. Now, unsharp filtering with contrast adjustment is applied only on the luminance component of the image & converts the result back to RGB component which resulted into a high contrast and zoomed color image in the output. After that RGB high contrast image is converted into HSV component & apply the color adaptive histogram equalization enhancement operator to intensity component only & after that finally convert the results back to HSV component.

This is our proposed method i.e. CA-UF with MCAHE algorithm, in which, firstly apply the interpolation & unsharp filter with contrast adjustment & MCAHE algorithm. This joint technique scheme is giving good agreement of result that is not possible with AHE method because AHE method may be applicable only in intensity image (black and white). Experimental result shows that the proposed method performs well in both PSNR and visual perception.

The higher the PSNR, the better the quality of the compressed or reconstructed image [8].The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR) are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error. The lower the value of MSE the lower will be error [9].
MSE is defined as:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[X(i,j) - Xc\,(i,j)]^2$$

Where,

X (i , j) =original image

X_c(i, j) =compressed image

PSNR represents a measure of the peak signal to noise ratio & is expressed in decibels. It is defined by:

$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right)$$

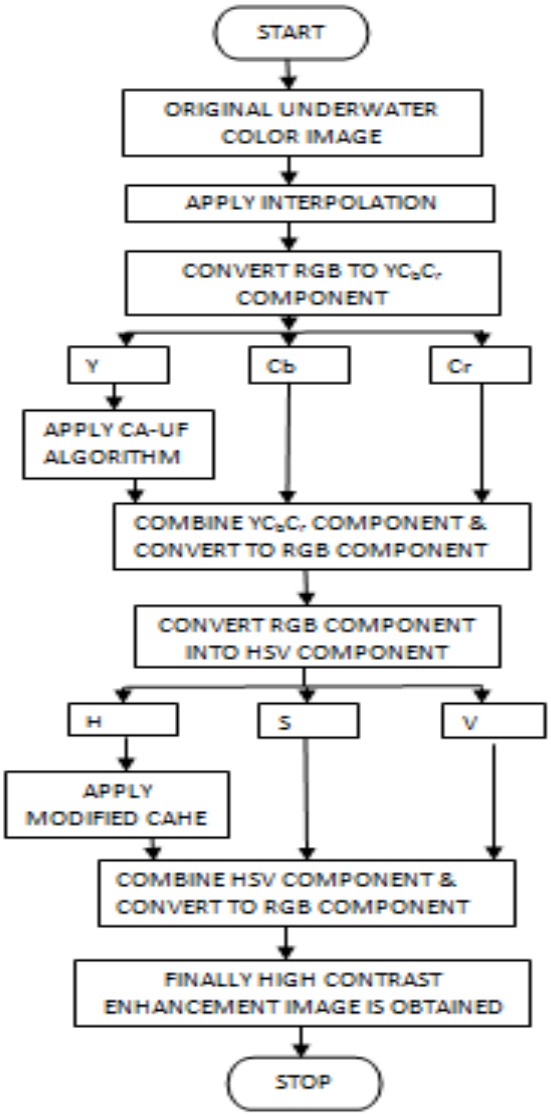


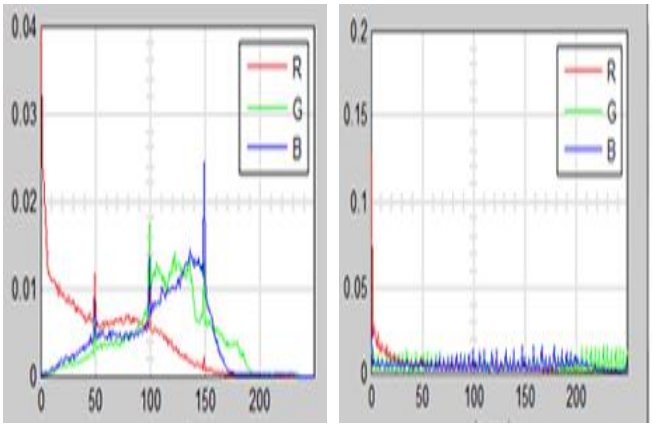
Figure 1: Flowchart of Proposed Algorithm

IV. RESULTS AND DISCUSSION

Experiments are performed on the 512 X 512 different underwater images. In Figure 2, 3, 4, 5 & 6 (a) original color underwater image & figure 2, 3, 4, 5 & 6(b) are the proposed method output images. Color Histogram plot as shown in

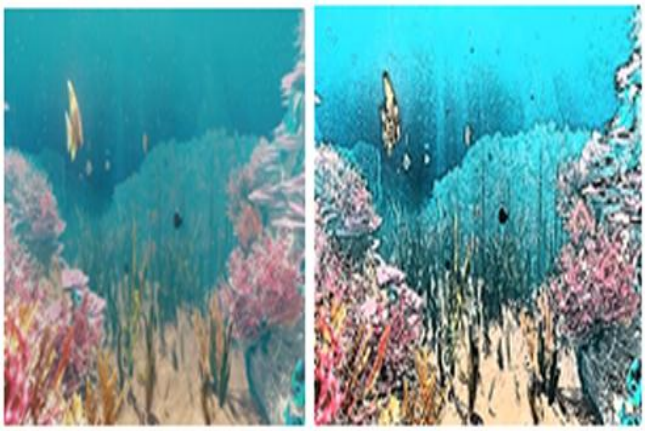
figure 2, 3, 4, 5 & 6 (c) & (d) is implemented using MATLAB [7.8.0.347(R2009a)].

(a) (b)

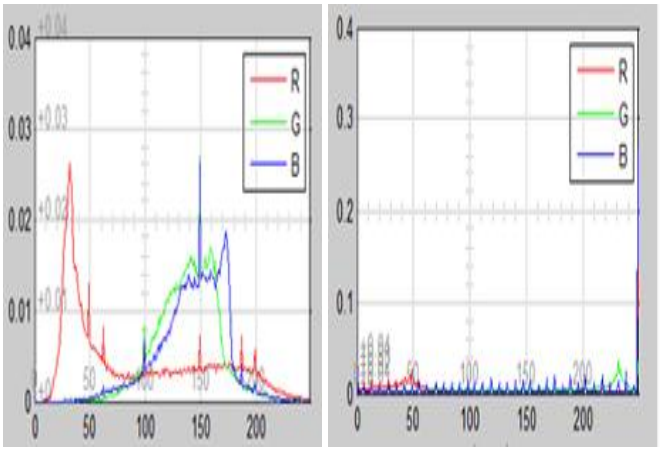


(c) (d)

Figure 2: Output of proposed algorithm with Histogram plot of TEST image 1 (a) original colour underwater image (b) output of proposed algorithm (c) colour histogram of original test image (d) color histogram of proposed method output image.



(a) (b)



(c) (d)

Figure 5: Output of Proposed algorithm with Histogram plot of TEST image 2 (a) original colour underwater image (b) output of proposed algorithm (c) colour histogram of original test image (d) color histogram of proposed method output image.

TABLE 1: ENHANCEMENT RESULT OF UNDERWATER TEST IMAGES

PARAMETER	TEST IMAGE	Enhancement Results	
		Existing Algorithm	Proposed Algorithm
PSNR	TEST IMAGE 1	42.56	49.86
MSE		4.41	1.93
PSNR	TEST IMAGE 2	45.56	50.56
MSE		2.67	1.12

V. CONCLUSION AND FUTURE SCOPE

In this paper, we proposed a preprocessing technique for enhancing the quality of degraded underwater images. In this paper, we proposed an image based preprocessing technique i.e. CA-UF-MCAHE algorithm to enhance the quality of the underwater images. The processing time of the proposed technique is very low compared to the preprocessing technique with other filtering. The proposed technique enhances the quality of the degraded underwater images which are suffered from non-uniform illumination, low contrast, noise and diminished colors.

REFERENCES

[1] Not available

Authors Profile

Ms. Ayushi Jaiswal received his Bachelor of Engineering from Rajiv Gandhi Technical University Bhopal,in 2011 and Master of Engineering in year 2014 (Gold medalist). She is currently working as an Asst Prof. in Shri Ram institute of science & technology, Jabalpur. she has published more than 7 research papers in reputed international journals including Thomson Reuters (SCI & Web of Science) and conferences including IEEE and it's also available online. Her main research work focuses on artifical intelligence, machine intelligence, computer vision, image processing & Communication system . She has 6 years of teaching experience and 3 years of Research Experience.

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