Enriched Enhancement of Underwater Images by L*A*B on Clahe and Gradient based Smoothing

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ABSTRACT

Image enhancement is a process of improving the quality of image by improving its feature. We proposed an image based preprocessing technique to enhance the quality of the underwater images. This paper present underwater image enhancement technique. The proposed technique l*a*b on clahe. This technique is eliminating by the most of researcher. To overcome the problem of existing technique a new l*a*b color space is proposed for enhancement. Different type of the images will be taken for experimental purposes to estimate the effectiveness of the image enhancement techniques. Different kind of image quality metrics has been used to find the significant improvement of the proposed technique over the available techniques.

Keywords
Underwater image preprocessing, Clahe, L*a*b

1. INTRODUCTION

Image processing is a form of signal processing in which input is an image and the output is either an image or a set of characteristics or parameters related to the image. The smallest element of an image is a pixel, also known as picture element. The processing of an image is done pixel by pixel. Underwater image enhancement techniques provide a method to improving the object identification in underwater enviroment.there is lot of research started for the improvement of image quality, but limited work has been done in the area of underwater images, because in underwater environment image get hazy due to poor visibility conditions and effects like "absorption of light", "reflection of light", "bending of light. These are the important factor which causes the degradation of underwater image. Almost no analysis has been performed on underwater pictures. The amount of light is reduced once we go deeper to the water and hence colors disappear 1 by 1 depending on the wavelength. Red colorization disappears at the depth of 3 m approximately. The orange color is lost at the depth of 5km. At the depth of 10 m the majority of the yellow goes off and finally the green and purple disappear at further depth. Since the blue color has got the shortest wavelength it travels the longest in water. The underwater images are therefore dominated by blue-green color. Underwater images impose several problems due mainly to light absorption, light scattering, light reflection and denser medium. These problems result in poor visibility of the underwater images. Absorption removes the light energy and scattering changes the direction of light path. These effects aren't only as a result of water but in Addition as a result of other components such as for example dissolved organic matter or small floating particles. You can find mainly two forms of scattering such as forward scattering and backward scattering. Forward scattering causes blurring of the image features and backward scattering reduces the contrast of the image.
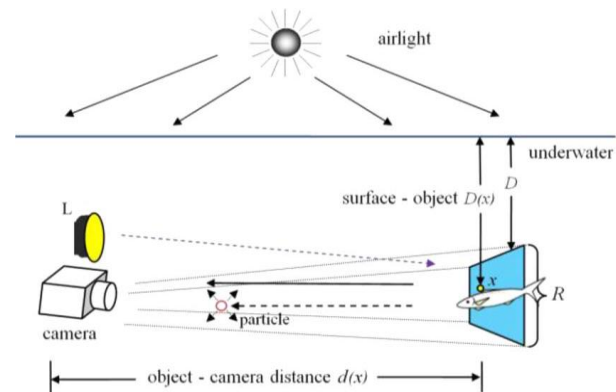

Fig.1 Effect of sun light on underwater image

2. LITERATURE REVIEW

Muhammad Suzuri Hitam et al. (2013) [13] have found of improving the feature of an underwater image has received considerable attention due to poor visibility of the image which is caused by physical properties of the water medium. This paper presents a new method called mixture Contrast Limited Adaptive Histogram Equalization (CLAHE) color models that specifically developed for underwater image enhancement. The method operates CLAHE on RGB and HSV color models and both results are combined together using Euclidean norm. Experimental results show that the proposed approach significantly improves the visual quality of underwater images by enhancing contrast, as well as reducing noise and artifacts.**Chen Hee Ooi et al. (2010) [6]** have described that Numerous histogram equalization (HE)-based brightness preserving methods tend to produce unwanted artifacts. Thus, they introduced two methods to overcome the drawbacks in which former method divides the histogram based on the median, and iteratively divides into the lower and upper sub-histograms, to produce a totally four sub-histograms. The separating points in the lower and upper sub-histograms are assigned to a new dynamic range and clipping process is implemented to each sub-histogram. They introduced that later method is the extension of the bi-histogram equalization plateau limit (BHEPL) that segments the histogram of input image based on its mean value and then, clipping process is implemented to each sub-histogram based on their median value. **Nyaml khagva Sengee et al.(2010)[7]** have found that

one widely accepted contrast enhancement method is global histogram equalization (GHE), which achieves comparatively better performance on almost all types of image but sometimes causes excessive visual deterioration. So they introduced a new method which is extension of bi-histogram equalization called Bi-Histogram Equalization with Neighborhood Metric (BHENM) which consists of two stages. They declared that in first stage, large histogram container causes washout artifacts, are split into sub-bins using neighborhood metrics; the exact same intensities of the first image are arranged by neighboring information. In the 2nd stage, histogram of the first image is separated into two sub-histograms on the basis of the mean of the histogram of the first image; the sub-histograms are equalized independently using refined histogram equalization, which produces flatter histograms. They showed in results that BHENM simultaneously preserved the brightness and enhanced the local contrast of the original image.**Zohaib Hammed et al. (2011) [8]** have found that the performance of an edge detection algorithm can be affected by serious noise & intensity in homogeneities. So they introduced a method aiming at detecting edge of image with varieties of gradient signal degradation which comprised two steps: adaptive histogram equalization and gradient modulation filtering process to improve the signal contrast in a discriminative manner. They revealed that this approach is applicable and effective to detect edges of poor images. **Yeong-Kang Lai, Yu-Fan Lai et al. (2011)[9]** have found that thin-film transistor liquid crystal display (TFT LCD) is widely used in handheld mobile devices but it consumes 20%–45% of total system power due to different applications. They also found that by controlling the backlight current to reduce the brightness and the contrast of LCDs can reduce the overall power consumption but this may cause significant changes in visual perception. So that they introduced new method to be able to reduce the energy consumption and get rid of the visual changes, the problem becomes. They introduced two new algorithms predicated on content analysis: the newest backlight-dimming algorithm (NBDA) and the newest image enhancement algorithm (NIEA). They observed that these algorithms can simultaneously reduce power consumption by 47% and increase the image enhancement ratio by 6.8% and also the structural-similarity index metric (SSIM) can be used to gauge image quality.**Seung-Won Jung et al.(2014)[11]** have introduced a new global contrast enhancement algorithm using the histograms of color and depth images. they have implemented this technique on the basis of the histogram-modification framework, the color and depth image histograms are first partitioned into subintervals using the Gaussian mixture model and the positions partitioning the color histogram are then adjusted such that spatially neighboring pixels with the similar intensity and depth values can be grouped into the same sub-interval. They declared that by estimating the mapping curve of the contrast enhancement for each sub-interval, the global image contrast can be improved without over-enhancing the local image contrast. **Gurvir Singh, et al. (2013)[12]** have found that in image enhancement various enhancement schemes have been used for enhancing which includes gray scale manipulation, filtering and Histogram Equalization (HE). They declared that existing techniques produce images with do not look as natural as the input ones and HE tends to introduce some annoying artifacts and unnatural enhancement. So to overcome these drawbacks,

they introduced that different existing defined brightness preserving techniques are used to check their performance measurement. They have done comparison on the basis of subjective and objective parameters. And they also found that subjective parameters are visual quality and computation time and objective parameters are Peak signal to- noise ratio (PSNR), Contrast and Error. **Shiwam S. Thakare1 et al.(2014)[13]** have described comparative analysis of various enhancement techniques for such underwater images. They found that underwater image suffers from low contrast and resolution due to poor visibility conditions, hence an object identification become typical task and the processing of underwater image captured is necessary because the quality of underwater images affect and these images leads some serious problems when compared to images from a clearer environment. They have found that a lot of noise occurs due to low contrast, poor visibility conditions, absorption of natural light, non uniform lighting and little color variations, and blur effect in the underwater images. so they declared that there is need to cure these underwater images by using different filtering techniques.**John Y. Chiang et al. (2012) [14]** have found that Light scattering and color change are two major sources of distortion for underwater photography and no existing underwater processing techniques can handle light scattering and color change distortions suffered by underwater images, and the possible presence of artificial lighting simultaneously. So they introduced that a novel systematic approach to enhance underwater images by a dehazing algorithm, to compensate the attenuation discrepancy along the propagation path, and to take the influence of the possible presence of an artifical light source into consideration.They declared that performance of this algorithm for wavelength compensation and image dehazing (WCID) is evaluated both objectively and subjectively by utilizing ground-truth color patches and video downloaded from the Youtube website. They have shown in results that images with significantly enhanced visibility and superior color fidelity are obtained by the WCID. **Pooja Sahu et al. (2014)[17]** Have introduced the techniques to enhance underwater image enhancement techniques. In addition they discovered that the processing of underwater image captured is essential because the caliber of underwater images affect and these image leads some serious problems like a large amount of noise occurs as a result of low contrast, poor visibility conditions (absorption of natural light), non uniform lighting and little color variations, pepper noise and blur effect in the underwater images when comparing to images from the clearer environment. They've observed that because of these reasons quantity of methods are existing to cure these underwater images using different filtering. They introduced that enhancement of underwater images one is image enhancement using median filter which enhances the image and help estimate the depth map and improve quality by eliminating noise particles with assistance from different techniques, and another is RGB Color Level Stretching have used.**Balvant Singh et al.(2011)[18]** have described the performance of contrast limited adaptive histogram equalization method is compared with contrast stretching, and histogram equalization method. For comparing the performance, they have applied mean square error and SNR as parameters. They applied this method on various type of underwater image environment for testing. They found that underwater image suffers from low contrast and resolution due to poor visibility conditions, so

object identification under water is difficult task. So they presented comparative analysis of various contrast enhancement techniques for such underwater images.**Sowmyashree M S et al. (2014) [17]** have found that the major sources for distortion of underwater images are light scattering and color change and water has high refractive index when compared to air. Hence, underwater images suffer from limited range visibility, low contrast, blurring, color diminished and noise. So they presented a comparative study of the various image enhancement techniques used for enhancing underwater image.**Cosmin Ancuti et al. (2012) [18]** have described a book strategy to improve underwater videos and images and built on the fusion principles, this strategy derives the inputs and the weight measures only from the degraded version of the image. to overcome the limitations of the underwater medium, they defined two inputs that represent color corrected and contrast enhanced versions of the first underwater image, but in addition four weight maps that aim to improve the visibility of the distant objects degraded as a result of medium scattering and absorption. They declared that this can be a single image approach that does not require specialized hardware or information about the underwater conditions or scene structure. Additionally they declared that fusion framework also supports temporal coherence between adjacent frames by performing a fruitful edge preserving noise reduction strategy and the enhanced images and videos are characterized by reduced noise level, better exposedness of the dark regions, improved global contrast while the best possible details and edges are enhanced significantly.
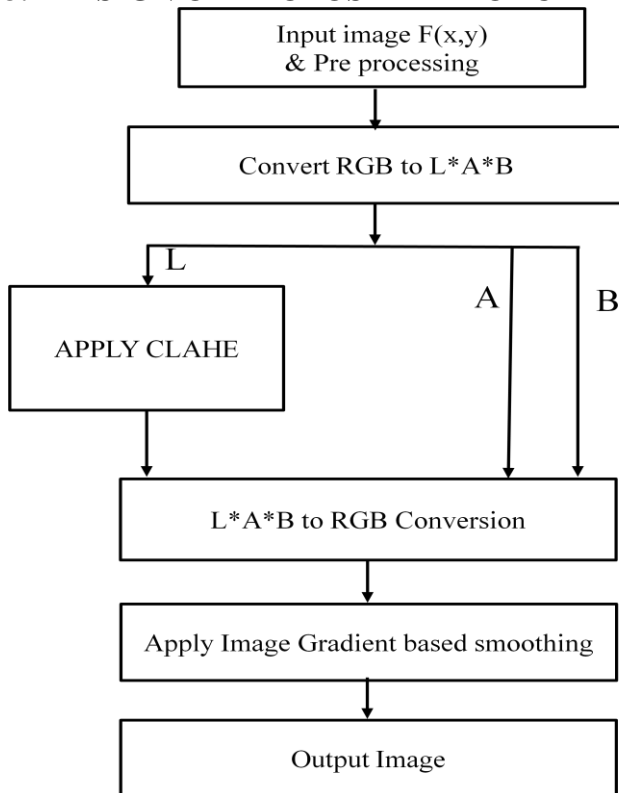
3. DESIGN OF PROPOSED APROACH

Fig.2 Flowchart of proposed methodology

4. EXPERIMENTAL RESULTS

The quality of the improved image was judged both in subjective ways from visual appeal and presence of unwanted color artifacts as well as by using objective statistical measures. The various types of image taken for experiment result. The mean square error (MSE), peak signal noise ratio (PSNR).The MSE represents the cumulative squared error between the Enhanced image and the original image, whereas PSNR represents a measure of the peak error.

The MSE is calculated using the following equation:

$$MSE = \frac{\sum M,N[I_1(m,n) - I_2(m,n)]^2}{M*N}$$

Where I_1 and I_2 denotes the original image and improved image respectively. The size of input image must be   same and are denotes by M*N. To compute the PSNR we can use the MSE .The MSE is calculated using the following equation:

$$PSNR = 20log10(\frac{2^B - 1}{\sqrt{(MSE)}})$$

Where β presented the bit per sample. In this work, β=8 because color images that range from 0-255 are used for experiment.

Table 1 Comparison of MSE

Image	Mix CLAHE	Proposed
1.jpg	3139.90	163.35
2.jpg	3087.70	365.26
3.jpg	6148.32	574.03
4.jpg	3064.30	819.13
5.jpg	514.77	491.80
6.jpg	3003.50	152.01
7.jpg	7162.14	236.07
8.jpg	1522.15	762.13
9.jpg	1523.17	259.26
10.jpg	1474.59	367.90
11.jpg	1909.48	601.26
12.jpg	1130.26	195.91
13.jpg	837.71	454.44
14.jpg	1631.23	337.63
15.jpg	1139.79	565.16

Graph 1 has shown the quantized analysis of the mean square error of different images using enhancement by Mix clahe transform (Blue Color), enhancement by LAB COLOR space transform (Red color) by Proposed Approach.
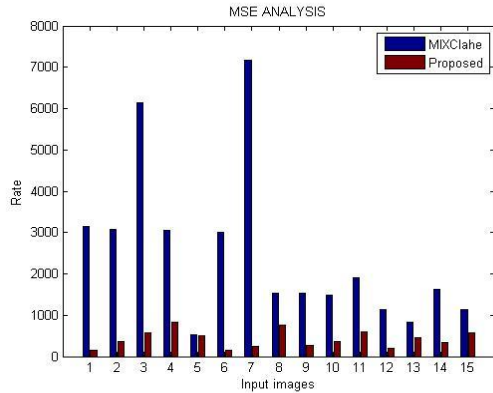
Graph 1 MSE of Existing & Proposed Approach for different images

It is very clear from the plot that there is decrease in MSE value of images with the use of proposed method over other methods. This decrease represents improvement in the objective quality of the image.

Graph 2 has shown the quantized analysis of the peak signal to noise ratio of different images using enhancement by Mix clahe transform (Blue color), Enhancement by LAB color space transform (Red Color) Proposed Approach.

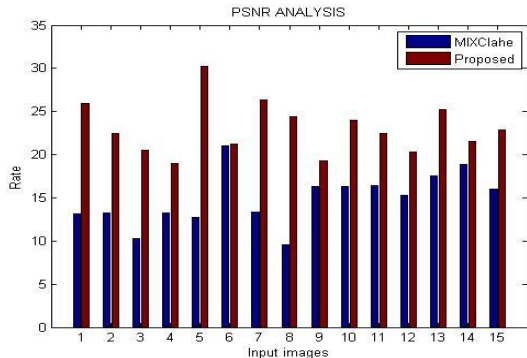**Table 2 Comparison of PSNR**

Images	Mix CLAHE	Proposed
1.jpg	13.16	25.99
2.jpg	13.23	22.50
3.jpg	10.24	20.54
4.jpg	13.26	18.99
5.jpg	12.78	30.26
6.jpg	21.01	21.21
7.jpg	13.35	26.31
8.jpg	9.58	24.40
9.jpg	16.30	19.31
10.jpg	16.30	23.99
11.jpg	16.44	22.47
12.jpg	15.32	20.34
13.jpg	17.59	25.21
14.jpg	18.89	21.55
15.jpg	16.00	22.84

Graph 2 PSNR of mix CLAHE & Proposed Approach for different images

It is very clear from the plot that there is increase in PSNR value of images with the use of proposed method over other methods. This increase represents improvement in the objective quality of the image. The values of MSE and PSNR are shown in Table 1, Table 2 respectively. It is clear that the CLAHE L*A*B model not only produced better results but also enhanced the image quality .The MSE value of proposed techniques is decreased almost in every case as compared to CLAHE-Mix and The result of PSNR value has shown that CLAHE L*A*B is highest for all test images.

Figure 1: Comparison of methods on. Upper left: original underwater image. Upper Right: Mix CLAHE image. Bottom left: L*A*B CLAHE image. Bottom Right: New Enhancement image

5. CONCLUSION AND FUTURE SCOPE

Underwater visual imaging and image processing play a vital role in oceanic scientific research and practical applications. yet, as light is absorbed and scattered by the water which it passes through, the underwater image acquired is seriously degraded. The resolution and contrast are lowered by light scattering and color is distorted by the wavelength-selective absorption. In order to resolve these problems, different artificial sources are widely used in underwater imaging systems. To overcome the problems of existing technique a new L*A*B color space and CLAHE based image enhancement algorithm is proposed in this research work. To overcome the issue of the uneven illuminate issue in the output image of the CLAHE output has been further removed using the use of image gradient based smoothing. The main scope of the proposed algorithm is to improve the accuracy of the underwater image enhancement techniques.

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