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Evaluation of single underwater image enhancement with CLAHE

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Abstract: This paper presents a new method called mixture Contrast Limited Adaptive Histogram Equalization (CLAHE) color models that specifically developed for underwater image enhancement. Firstly, the contrast stretching of RGB algorithm its applied to equalize the color contrast in images. Secondly, the saturation and intensity stretching of HSI is used to increase the true color and solve the problem of lighting. Interactive software has been developed for underwater image enhancement. In this we will be discussing about the degradations due to bad weather such as underwater, underwater small fish, gold fish and underwater apple in an image. The image quality of outdoor screen in the underwater and underwater fish weather condition is usually degraded by the scattering of a light before reaching the camera due to these large quantities of overhanging particles (e.g. underwater, underwater fish, gold fish, apple underwater impurities) in the environment. General contrast enhancement approaches can be applied for image debasing, such as linear or gamma correction, unship-masking, or histogram equalization. As haze is not constant over an image, these techniques cannot be applied globally as they would degrade haze-free regions. Results of the software are presented in this paper.

Keyword: Performance evaluation; Parameters; MSE; PSNR.

I. INTRODUCTION

Dissemination is caused by two principal phenomena such as reduction and air brightness. By the usage of effective removal of image, we can improve the stability and robustness of the visual system.

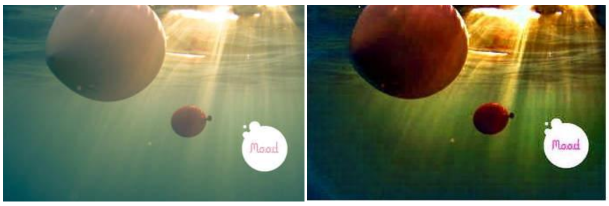

Fig 1.1: (a) Original (b) image processed image

Haze removal is a tough task because underwater depends on the unknown scene depth information. Haze effect is the function of distance between camera and object. Hence removal of Haze requires the estimation of air light map or depth map. The current haze removal method can be divided into two categories: image enhancement and image restoration. Image enhancement does not include the reasons of Haze degrading image quality. This method can improve the contrast of haze image but loses some of the information regarding image. Image restoration firstly studies the physical process of image imaging in underwater weather. After observing that degradation model of Haze image will be established. At last, the degradation process is inverted to generate the underwater free image without the degradation. So, the quality of degraded image could be improved.

1.1 Gaps in literature

A major difficulty to process underwater images comes from light attenuation. underwater removal algorithms become more beneficial for numerous vision applications. It has been originated that the most of the existing research have mistreated numerous subjects. Following are the various research gaps concluded using the literature survey: -

1) The presented methods have neglected the techniques to reduce the noise issue which is presented in the output images of the existing underwater removal algorithms.
2) Not much effort has focused on the integrated approach of the Adaptive histogram equalization and Dark channel prior.
3) The problem of the uneven illuminate is also neglected by the most of the researchers.

Under water image enhancement based algorithms become more useful for many vision applications. It is found that most of the existing researchers have neglected many issues; i.e. no technique is accurate for different kind of circumstances. The existing methods have neglected the use of dark channel prior to reduce the noise and uneven illuminate problem. To overcome the problems of existing research a new integrated algorithm is proposed. New algorithm will integrate the dark channel prior and mix-CLAHE to improve the results further. The bilateral filtering will also be used as a post-processing step to remove the noise form the input image.

EXPERIMENTAL SETUP

All the images are randomly picked from the internet and some of these images are also previously used in the results of the some of the paper we used for literature survey. All the images are of different kind so that it could be justified that proposed algorithm can give better result in all cases.

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II. PERFORMANCE EVALUATION

Figure 2.1 has shown the first input teddy image which is passed to the proposed algorithm and other existing technique. The result of input image shows that the trunk and leaves of tree have better natural color for proposed method as comparative other method.

Figure 2:1 s 1st original image input 2) CLAHE Output 3) proposed output

In PROPOSED 1st image result the underwater is more effectively removed and the brightness of image is also retained. Table 2.1 is showing the comparison of the all technique with PROPOSED on two different parameters.

TABLES AND GRAPHS FOR PARAMETERS

The comparison among proposed and other available methods will be drawn by taking the following parameters:

- Mean square error
- PSNR
- Contrast gain

2.1 Mean Square Error

MSE stands for mean square error. Mean Square Error (MSE) of an estimator is one of many ways to quantify the difference between values implied by an estimator and the true values of the quantity being approximate.

Table 2.2: Mean Square Error Comparison of Different method

Image no.	Proposed	CLAHE
1	43	75
2	264	733
3	27	210
4	57	523
5	53	83
6	17	126
7	227	564
8	15	135
9	109	538
10	36	467
11	121	162
12	151	229
13	24	170
14	27	382
15	37	89

The difference between mean square varies according to the density of underwater the images with denser underwater shows greater difference and with less underwater shows less difference. So, proposed method shows better result for both cases.

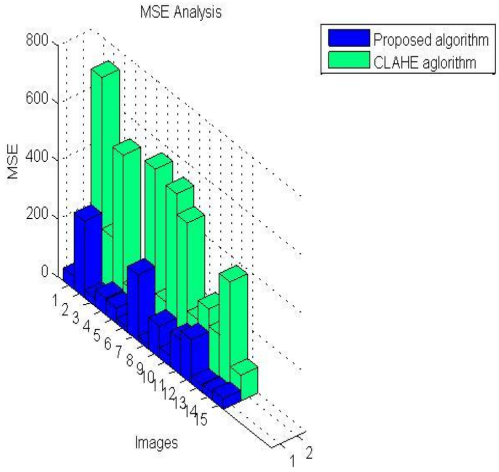

Figure 2.3: MSE graph between Proposed and CLAHE image

As, mean square error should be reduced so it is observed from graph that value of mean square error for PROPOSED method in every image is less than the mean square error of CLAHE method.

The difference between mean square varies according to the density of underwater the images with denser underwater shows greater difference and with less underwater shows less difference.

So, proposed method shows better result for both cases.

3.1. PSNR

Signal-to-noise ratio (reduced **SNR** or **S/N**) is a measure used in science and engineering that compares the level of a desired signal to the level of background noise.

A ratio higher than 1:1 (greater than 0 dB) indicates more signal than noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal.

It is definite as the ratio of signal power to noise power, over and over again articulated in decibels. Signal-to-noise ratio is defined as the ratio of the power of background noise.

(Useless pointer) and the power of a signal (important in order).

SNR=P signal/P signal

Where P is average power. Both signal and noise power must be measured at the same and equivalent points in a system, and within the same system bandwidth.

PSNR difference between the proposed and CLAHE.

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Table 3.2: PSNR Comparison of Different method

Image no.	Proposed	CLAHE
1	24.3940	**21.3270**
2	16.5073	**13.9606**
3	27.6614	**17.2218**
4	22.7721	**14.7131**
5	23.1236	20.8201
6	16.9667	14.5369
7	32.1217	19.0264
8	33.6156	18.7663
9	19.6121	14.6476
10	25.5783	14.9829
11	19.1978	18.0916
12	**18.3363**	**16.9418**
13	**28.8087**	**17.9178**
14	**27.9214**	**15.4910**
15	**25.3933**	**20.4699**

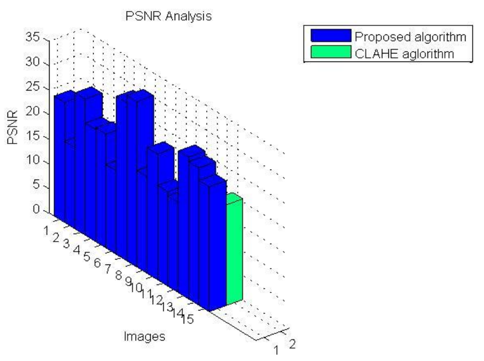

Figure 3.3: PSNR graph between Proposed and CLAHE image

As, PSNR should be reduced so it is observed from graph that value of PSNR for PROPOSED method in every image is less than the PSNR of PROPOSED method. The difference between PSNR varies according to the density of underwater the images with more dense underwater shows greater difference and with less underwater shows less difference. So, proposed method shows better result for both cases.

III. CONTRAST GAIN

Human sensory systems have the remarkable ability in the human visual system by using a clever method that measured both increases and decreases in firm of adjusting sensitivity to the surrounding environment.

In this issue of Neuron, Gardner and colleague's responses around a mean level of contrast. They showed that, after prolonged exposure to high Con-Used firm to show how the visual system shifts its sensitivity to contrast.

This process may be helpful trusts, the "dynamic range" of the contrast response function in early cortical visual areas shifted from for keeping the appearance of contrast constant across a range of spatial frequencies.

Table 4.2: Contrast gain Comparison of Different method

No. of images	Proposed	CLAHE
1	14.9904	11.8832
2	5.5964	2.9721
3	11.3338	6.6756
4	10.9502	4.3081
5	13.3388	10.8392
6	19.2402	9.1325
7	6.8760	4.0510
8	20.6607	9.4429
9	6.9332	4.0937
10	11.8108	4.0125
11	8.6227	9.3459
12	6.7616	8.7297
13	14.9706	7.2487
14	12.6590	4.4815
15	16.3718	11.8660

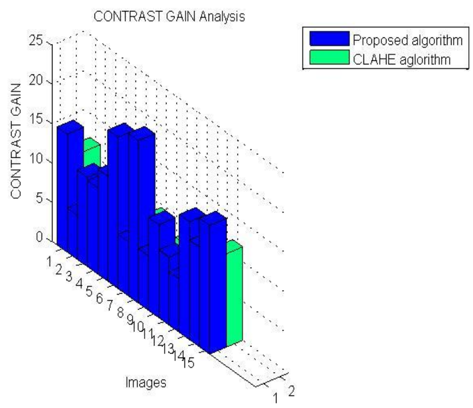

Figure 4.3:- Contrast gain graph between Proposed and CLAHE image.

As, contrast gain should be reduced so it is observed from graph that value of contrast gain for PROPOSED method in every image is less than the contrast gain of CLAHE method. The difference between contrasts varies according to the density of underwater the images with more dense underwater shows greater difference and with less underwater shows less difference. So, proposed method shows better result for both cases.

IV. CONCLUSION

Underwater removal algorithms become more useful for Many vision applications. It is found that most of the Presented researchers have ignore many issues; i.e. No technique is better for different kind of situation. The on hand methods have neglect the use of gamma correction and histogram stretching to reduce the noise problem which will be presented in the output image of the existing underwater removal algorithms. To reduce the problems of existing literature a new integrated algorithm has been proposed that has integrated the dark channel prior with CLAHE to enhance the results further. The proposed algorithm is designed and implemented in MATLAB using image processing toolbox. The comparison among CLAHE and the proposed algorithm is also drawn based upon certain performance parameters. The comparison analysis has shown that the proposed algorithm has shown quite effective results. The main scope of the proposed algorithm is to improve the accuracy of the Intelligent Transportation System (ITS) in particular when lane detection kinds of application come in action in VANETs.

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