Underwater Image Restoration using Multi-Scale Retinex

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Abstract— Underwater images (UI) generally demonstrate color distortion & low contrast as the outcome of exponential decay that light goes through as it travels. Furthermore, colors linked to diverse wavelengths have various attenuation rates. Light scattering (LS) & color change are 2 major issues in UI. Due to LS, incident light gets reflected & deflected numerous ways via particles current in the water. Dark channel prior (DCP) is an easy but efficient image prior. DCP system utilized for eliminates haze current in UI. But it may be invalid when the scene containing sky. We also have used red- DCP was distinct & resultant to approximation background light & transmission. In our proposed work, we have used multi-scale retinex to restore our image.

Keywords— Underwater image restoration, dark channel prior, Red dark channel restoration, Transmission estimation, improved automatic White balance, multi-scale retinex.

I. Introduction

UI is broadly utilized in scientific research & technology because of less rate of execution while compared with the additional sophisticated method. As UI is still challenging is because of the physical properties of underwater (UW) circumstances. A UI is signifying as a linear superposition of straight component. Temporarily alike forward scattering basis blurring of picture features as backscattering masks information of circumstances. In water, natural enlightenment also undergoes tough color-dependent attenuation.
As a consequence, UI usually has predominantly green-blue hue. Generally, bad visibility & color cast basis via belongings of UI circumstances deteriorate the ability to completely extract important data via UI for additional processing like marine mine discovery. As it huge concentration to restore degraded UI for maximum quality UI. [1]

Acquiring apparent pictures in UW surroundings is a considerable concern in ocean engineering. Feature of UI has a crucial function in a technical assignment like monitoring sea life or biological surroundings. Having Pictures UW is demanding, typically because of haze basis on the light. UI constantly conquered via bluish tone. Light scattering & color (L&C) alter consequence picture obtains UW. As an ex. as it is shown in Fig.1. Haze is because of suspended matter like sand & minerals.

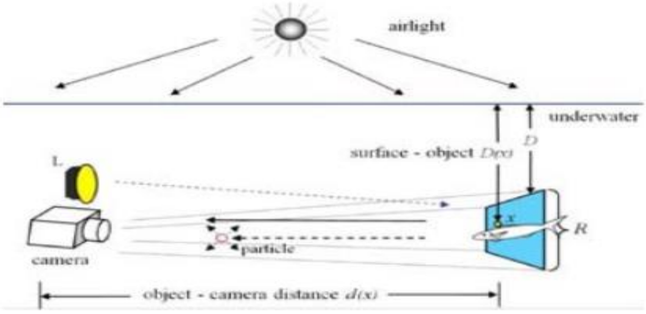


Figure 1. Natural light enters from air to a UW sight point.

L&C modify is accurate via contrast enhancement & image dehazing methods. The image dehazing is effectively an under-constrained issue. Common standard to resolve like issues is consequently to investigate additional priors or constraints. [2]
Further, this paper is structured as follow. Section II shows various techniques & details of the proposed system, Section III shows literature survey of the previous scheme, Section IV present propose work and Section V presents experiment result analysis and conclusions of the study shows in section VII.

II. Using Techniques

In this paper we have used these techniques which are described below:

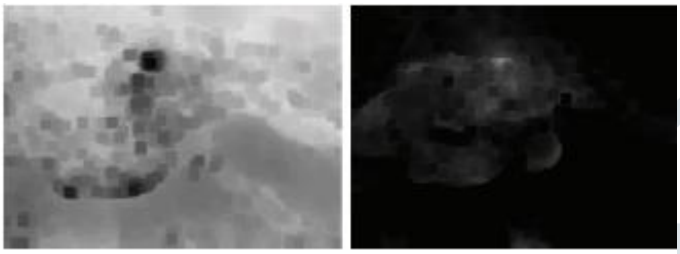
a. Dark channel prior (DCP)

The DCP is considered on statistics of outside haze-free images (HFI). In nearly all slightest one color channel (OCC) has extremely less few pixels. These dark pixels (DP) offer an assessment of haze transmission. This demand is physically suitable & work fine in a dense haze. As prospect objects are alike to air light then it is unacceptable. DCP that is considered on inspection on outside HFI: mainly non-sky patches, slightest OCC has extremely less intensity at few pixels. The DCP is usually influential prior for single image dehazing, it is not unacceptable while objects that are alike colors to atmospheric light. It is complicated to discover precise transmission issue & consequences illustrate a few color distortion. The less intensity in DCP is generally because of 3 things: shadows, colorful objects & dark things. More recently, it utilized statistical inspection on HFI that is termed “DCP” for assessment of sight depth. [3]
This method is essentially helpful for single picture dehazing. It utilized to evaluate statistics of outside fog-free pictures. Visualize some pixels extremely less intensity in someone of the color channel. These pixels are termed as DP. DP is utilized to analyze the transmission map (TM). TM is utilized to reduce the little blocky result. TM is probably precisely essentially low intensity like patch requires having extremely less value. DCP is considered by,

dark(x)=min{min{Jc(y)},
y∈Ω(x) c∈{r,g,b}
Where J' is a color channel of J & Q(x) is a local.
The DCP is considered on statistical features of outside HFI: slightest OCC has few pixels whose intensities are extremely less in mainly nonsky patches. DCP techniques can create ordinary HFI. [4]

b. Red dark channel restoration (RDCP)

When we evaluate maximum & minimum visibility possessions in UI, the experimental intensity in red is simply precious via manipulating of attenuation. Supplementary distance is less intensity camera identify. Therefore, DCP is redefined for UI. [5]



(a) (b)

Fig. 2. Evaluation in haze estimation (a) red-DCP (b) traditional DCP.

c. Transmission estimation

To approximation media transmission, we utilize saturation assessment metric & intensity dissimilarity. Primary, picture pixels R, G & B are symbolized via value amid 0 & 255. The picture with pixel values mainly consistently spread like range consequences better contrast. Though few pixels of dehazed picture are mapped outside, successive truncation to 8- bit mapping can consequence deterioration of picture, foremost to failure of data in the procedure. For reducing the failure of data, we implement approximation transmission. [6]

d. Improved automatic White balance

The algorithms & method utilized to achieve process have the frequent objective to render white objects as white beneath whichever light source & usually referred to as gray balance or white balance (WB) method. The linear models function merely on 2 color channels & therefore support diminish computational complexity of the system. Additionally this technique of WB improvement does not initiate a few major alter in picture brightness as a green channel, that supply mainly. WB presentation of projected system is authenticating onset of pathological pictures. [7]

Automatic White Balance (AWB) is one of mainly significant purpose for video cameras to attain maximum quality pictures. When a white object is enlightened beneath less color visible as bluish beneath maximum color temperature. AWB is introducing in sort to create image further natural. Current AWB algorithms can be categorized into 2 kinds, global AWB algorithms (GAA) & local AWB algorithms (LAA). The GAA utilize overall pixels of a picture for color temperature assessment, LAA only these pixels that assure few particular circumstances are concerned. [8]

III. Literature Survey

Changli Li et.al. [2018] To address the shortcoming of the classical DCP algorithm for establishing UI restoration (UIR), we propose a new algorithm for UIR considered an enhanced background light estimate (BLE) & AWB. An improved BLE process can decrease the impact of white light & matter & enhance the accurateness of BL. Enhanced AWB algorithm can decrease color distortion & achieve a clearer picture with color correction of the restored picture. [9]

Ryo Tanikawa et.al. [2018] In this paper, the latest technique for establishing IR via match up of various sound & blurred artwork. Aa picture is taken via camera with various exposure times & reproduced picture have maximum quality. Few reorganization systems utilizing various degraded picture. Mainly techniques resolve the optimization issue of simultaneous noise removal and blurring. However, this approach cannot easily deal with noise removal & blurring. We usual weight of 2 picture to create a picture for the restoration system. Inclusion picture sounds & blurred artifact effectively suppressed as preserving helpful picture data. We thus propose an easy restoration technique & have a high quality reorganized picture. An experimental outcome present that suggests techniques achieve high quality re-installed picture that has detached the noise & shielded edges. [10]

Neha et.al. [2017] The haze phenomenon degrades the visibility of a scene in the film. DCP is a widely used technique for removing fog. The methods deployed in this model evaluate the transmission map with a constant transmission parameter. In this paper, we observe the output obtained at different constant transmission parameters for different filters. We also studied the effects of varying the patch size of the image. The results show that an amplify in the constant transmission parameter guides to an amplify in the intensity of sight. We conclude that as the patch size increases in the DCP, the image quality increases and the noise decreases. [11]

Amjad Khan et.al. [2016] Mainly UI have a layer of fog, which is produced via suspended particles in turbulent water, which scatter & absorb light. Light attenuation limits visibility due to the blurring of the absorption image quality and eventually, UI took via camera like the medium is obscure & degraded evaluate to the usual picture captured in the environment. In this paper, we suggest a wavelet-based fusion technique for enhancing & destroying UW haze picture of the corroded pipeline. [12]

Yujie Li et.al. [2015] This paper describes fresh techniques for augmenting optical images or videos in the shallow ocean using fast DCP denaturing techniques. Absorption, dispersion & color distortion are the 3 main defective issues for UI. In this paper, we suggest fresh shallow water imaging model address attenuation mismatch in the campaign trail and the effective UW scene improvement plan. [13]

P. Drews Jr et.al. [2013] This paper suggests a technique for estimating transmission in UW surroundings based on an adaptation of DCP statistic considered on the characteristics of pictures produced in the Tudor landscape. This method, known as UW DCP, is mainly a blue & green channel that is considered a UW visual data supply, enabling a major development above accessible DCP-based methods. During relative revise of cutting-edge methods, shows the comprehensive investigation of the method, showing the applicability & restrictions of pictures obtained via actual & simulated prospect. [14]

IV. Propose Work

Problem statement:

- A big uniformly colored object is present.
- Due to the low light intensity, it is difficult to determine the illuminant spectrum.
- Auto white balance (AWB) normally provides colors that are not better as they are, also not consistent from frame to frame.
- AWB is planned to frequently alter & adapt to various circumstances.

Propose methodology:

The common outcome of retinex processing on pictures with regional or global gray-world violations (GWV) is “graying out” of pictures or in locations. This desaturation of color in few situations, harsh more rarely GWV can merely create unpredicted color distortion. As reflect on color restoration system gives better color rendition for pictures will have GWV. Here it needed restoration to conserve a reasonable degree of color consistency. Color constancy is called for inadequate in individual illustration observation, few levels of illuminant color dependency (CD) is satisfactory, offer greatly lesser than objective spectrophotometric variations. Eventually, particles of picture quality & CD is supportable to point to illustration deficiency is not visually too tough.

Propose Algorithm:

1. First, we browse image from the dataset.
2. Then we use DCP on this original image.
3. Then we apply RDCP on this image.
4. Then use transmission estimation on this RDCP image.
5. Apply improved automatic white balance.
6. Apply MSR multi-scale retinex).
7. Calculate parameter entropy, mean and standard deviation.
8. Exit.

Flow chart:

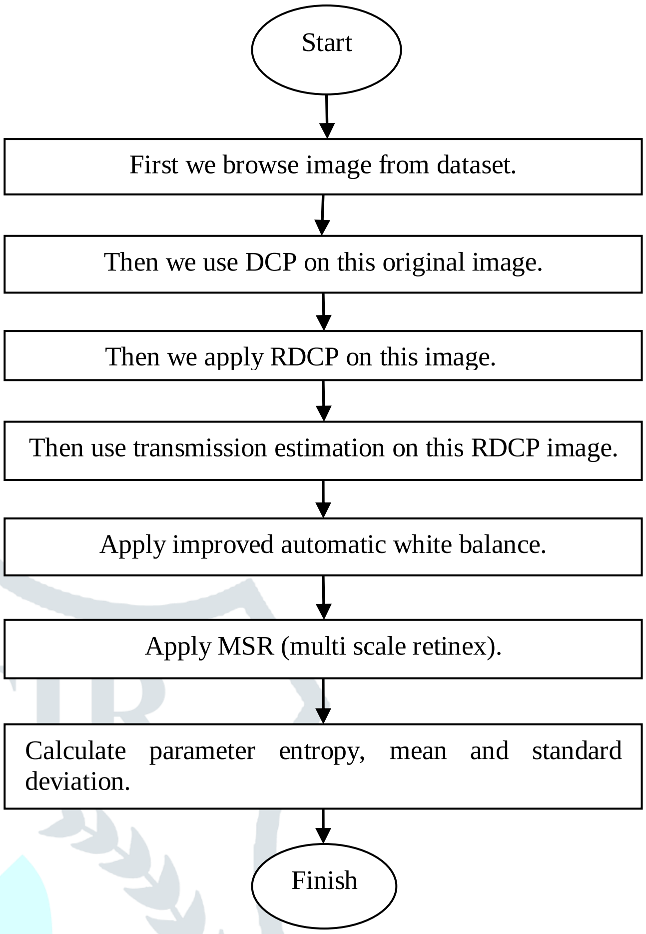


Fig 3. Flow chart of proposed work.

V. Experiment Result Analysis

In our experiment first, we take an image from dataset then in the original image we apply DCP and RDCP. The image quality is reduced and then after that, we apply the white balance in our image. After that, we apply our proposed algorithm in our paper. First, we run this code and obtained this type of menu bar.

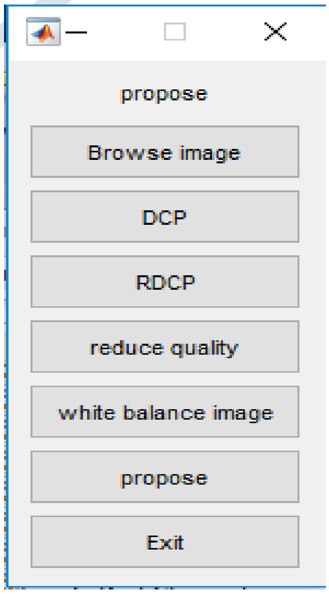


Fig.4. There are 7 steps in this menu bar.

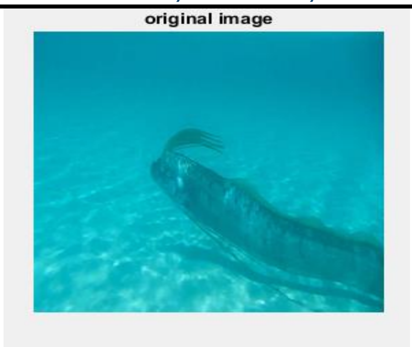


Fig.5. First, we browse image from the dataset.

Fig.6. Then we use DCP on this original image.

Fig.7. Then we apply RDCP on this image.

Fig.8. Then use transmission estimation on this RDCP image.

Fig.9. Apply improved automatic white balance.

Fig.10. Apply MSR (multi-scale retinex).

Results

Table 1: Comparison of Base Entropy and Propose Entropy in different images.

Image name	Base Entropy	Propose Entropy
1.jpg	6.3223	5.9945
Fish	5.6850	6.2600
image	6.7682	7.4491

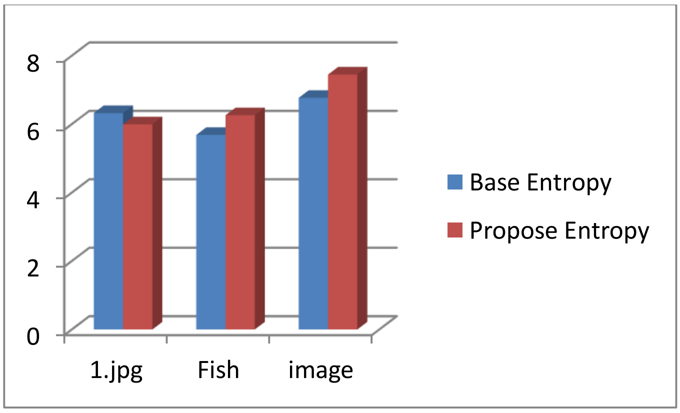


Fig 11. Graph comparison of Base Entropy and Propose Entropy in different images.

Table 2: Comparison of Base Standard deviation and Propose Standard deviation in different images.

Image name	Base Standard deviation	Propose Standard deviation
1.jpg	20.0690	15.6244
Fish	51.8878	50.8909
image	64.2627	61.3811

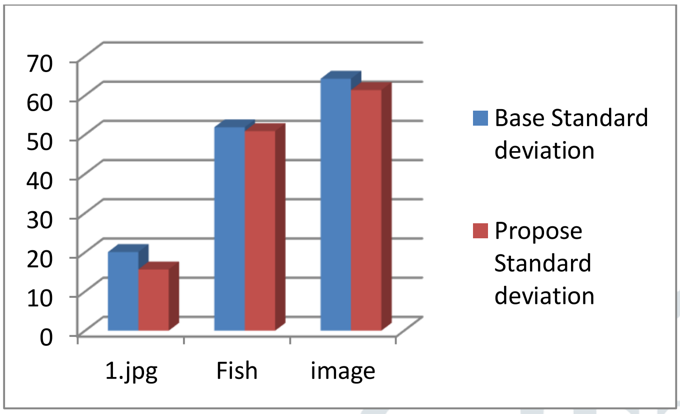


Fig 12: Graph Comparison of Base Standard deviation and Propose Standard deviation in different images.

Table 3: Comparison of Base Mean and Propose Mean in different images.

Image name	Base Mean	Propose Mean
1.jpg	90.3359	135.3711
Fish	104.8594	155.7109
image	125.9883	186.9492

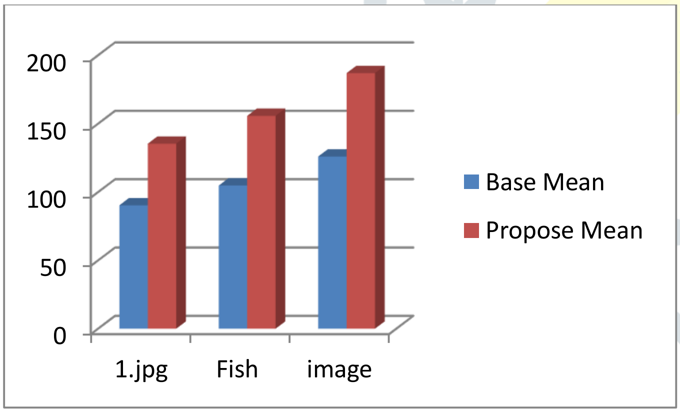


Fig 13. Graph comparison of Base Mean and Propose Mean in different images.

VI. CONCLUSION

UI plays a significant function in the marine investigation. Because of the particular physical properties of UW surroundings, UI is diverse from general ones like complicated noise distribution, serious scattering & absorption. In UW visibility is low due to light absorption & radiation. As a consequence of these issues, UI has low contrasts & resolutions. In this paper, we proposed a UI restoration model considered using MSR to improve the contrast of the image. We also terminate that the image quality increases and noise reduction as patch size amplifies in DCP. The DCP is extremely easy but powerful for single image haze removal. Applying prior to haze imaging model, haze is competently reduced.

For future effort, we aim to concentrate on beyond given issues. Furthermore, begin the UI database for growth of UI & video investigation. Also, further enhancement systems & learning methods can be utilized to recover processing consequence of proposed methods.

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