Analysis of Under Water Image Enhancement by Using LCIE ,AGCWD, CLAHE, DWT, LPM, HMF Techniques

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***Abstract:** Image enhancement (IE) is the process of improving the quality of the input image so that it would b easily understood by viewers in the future. Underwater image (UI) specifically be afflicted by the trouble of bad color evaluation and poor visibility. These issues came about because of the scattering of mild and refraction of mild at the same time as entering from rarer to denser medium. Many strategies and strategies are installed with the aid of researchers to clear up the trouble of underwater image enhancement (UIE). In this paper comparative assessment of numerous enhancement techniques for such UI is presented. The UI suffers from low comparison and determination because of negative visibility situations, for this reason object identification grow to be usual venture. The processing of UI captured is vital due to the fact the exceptional of UI have an effect on and those images leads a few severe problems when in comparison to photos from a clearer environment. A lot of noise happens because of low assessment, terrible visibility situations, absorption of natural mild, non-uniform lighting and little color variations, and blur impact inside the UI, because of some of these motives range of strategies are there to remedy these UI, exclusive filtering techniques also are to be had inside the literature for processing and enhancement of underwater images.*
***Keywords:** AGCWD; CLAHE; LPM; DWT; MSR; HMF; LCIE;*

I. INTRODUCTION

Digital image processing (DIP) is an important research area that makes use of computer algorithms for analysis and interpretation of digital images (DI). IE is one of the crucial phases of common image recognition (IR) and interpretation system. It is the preprocessing step that serves as an important step towards the solution for image analysis. It refers to the techniques used for improving the interpretability or perception of information in any image by increasing the distinction between the features of the image. IE especially reveals its significance inside the discipline of analysis of medical images, aerial and satellite pictures, surveillance structures, astronomy, commercial packages, forensics and so on.

In IE, a picture is manipulated so that the end result is extra suitable than the authentic for any specific reason. The enhancement can be executed both in spatial domain (SD) or frequency domain (FD). FD enhancement methods carry out amendment on Fourier transformation (FT) of the unique picture where as in SD enhancement techniques the pixels in a picture are directly manipulated. Spatial feature manipulations are normally local operations where the significant pixels values are calculated with recognize to their neighbourhood pixels. Filtering techniques and area enhancement are a number of the neighborhood operations for IE.[1].

There are many IE techniques for enhancement of UI. They are: Contrast Limited Adaptive Histogram Equalization (CLAHE) and Histogram Equalzation (HE) [2]. The HE is very common technique for IE. The classical HE can correctly utilize display intensities, however it tends to over enhance the comparison if there are excessive peaks inside the histogram, which regularly consequences in a harsh and noisy appearance of the output picture. Numerous methods have been proposed for limiting the level of enhancement, most of which are obtained through modifications on HE. A histogram modification framework (HMF) proposed in poses comparison enhancement as an optimization that minimizes a price characteristic. Recently, a contrast enhancement using adaptive gamma correction with weighting distribution (AGCWD) is proposed, which smoothes the fluctuant phenomenon by weighting distribution and enhances image automatically using gamma correction (GC). To overcome these drawbacks, local histogram equalization (LHE)-based methods are proposed. CLAHE proposed via Pizer and so on. Is a classic LHE-based totally IE approach, which first separates the picture into numbers of continuous and non-overlapped sub-blocks, then complements each sub-block for my part and ultimately makes use of an interpolation operation to lessen the block artefacts.

II. LITERATURE SURVEY

Huang Lidong, et.Al. [8] IE has a crucial position in image processing (IP) applications. CLAHE is an effective set of rules to beautify the neighborhood information of a picture. However, it faces the evaluation overstretching and noise enhancement troubles. To clear up these problems, this take a look at provides a unique IE method, named CLAHE-discrete wavelet transform (DWT), which mixes the CLAHE with DWT. The new method includes three principal steps: First, the authentic picture is decomposed into low-frequency (LF) and high-frequency (HF) components by way of DWT. This is because the HF aspect corresponds to the element information and consists of maximum noises of authentic picture. Finally, reconstruct the picture through taking inverse DWT of the new coefficients. To alleviate over-enhancement, the reconstructed and authentic pictures are averaged using an at first proposed weighting component. The weighting operation can manage the enhancement ranges of areas with exceptional luminance's in original picture adaptively. This is critical because bright parts of picture are commonly needless to be more desirable in assessment with the dark components. Extensive experiments display that this approach performs properly in element maintenance and noise suppression

Sharifuzzaman Khan, et.al. [9] In this project multi-scale image analysis is utilized as fundamental IE method with the assistance of Laplacian Pyramid (LP). The objective is accomplished by making an interpretation of an image into a few picture scales and recreating with enhancement tools available in MATLAB IP toolbox. Results are evaluated with object background contrast ratio, contrast- noise -ratio and 2-D contour plot. The enhanced images show up as a superior source for edge detection and vessel extraction compare with the primary picture. For this project normal fundus picture from publicly available database are chosen.

Suprijanto, et.al. [10] Quality of digitized picture utilizing transmission mode is advanced to something utilizing mirrored image mode. Be that as it may, if coordinate DI is utilized as a highest quality level, picture upgrade on digitized image is still required. Four strategies, i.e. contrast extending, HE, AHE, and CLAHE are utilized to endeavor enhance the quality digitized image. Assessment of the inclination image quality is performed in view of objective criterion. The inclination picture quality for digitized all using so as to panoramic picture can be acquired IE taking into account CLAHE-Rayleigh technique, that demonstrated by the most reduced estimation of mean, standard deviation, RMSE, and normal distinction and the higher estimation of NAE and SAE.

Hiroshi Tsutsui,et.al.[11] In this paper, we endorse a unique halo discount approach for variational based Retinex IE. In variational based Retinex image upgrade, a cost capacity is composed in view of the illumination characteristics. The enhanced picture is gotten by removing the brightening part, which gives least cost, from the given input picture. In spite of the fact that this methodology gives great upgrade quality with less computational cost, an issue that dark areas close edges remain dark after IE, known as halo artifact, still exists. With a specific end goal to smother such artifacts effectively, the proposed technique adaptively changes the parameter of the cost capacity, which impacts the exchange off connection between decreasing radiance antiques and saving IC. The proposed technique is material to a current realtime Retinex IE hardware implementation.

Amiri, et.al.[12] In method known as AGCWD changed into presented that modify histograms and beautify evaluation in DI. In this paper, a hybrid HM (histogram modification) method turned into proposed through combining Transform GC and THE (Traditional histogram equalization) strategies. In this method cumulative distribution feature (CDF) is utilized without delay and normalized gamma feature is implemented to adjust the transformation curve. In adaptive gamma correction (AGC) method compensated CDF is used as an adapted parameter. The AGC approach increases low depth and avoids vast decrement of high depth. In Weighting distribution the enter histogram or probability distribution function (PDF) is changed in such manner that the infrequent gray tiers are given tremendously greater chances (or weights) than the frequent grey degrees. Results of paper showed that this method produced enhanced images of comparable or higher quality than those produced using previous methods.

III. PROPOSE TECHNIQUES

A. Adaptive Gamma Correction with Weighting Distribution (AGCWD)

To do away with the above mentioned hassle AGCWD is brought which makes use of pdf of input picture in calculating adaptive parameter ϒ but it does not use pdf as it is, it makes some changes in pdf and calls it weighted pdf.[3] This weighted pdf modifies the original histogram and lessen the generation of aderse effects. The weighted pdf is calculated as

$$pdf_w(I) = pdf_{max}(\frac{pdf(1) - pdf_{min}}{pdf_{max} - pdf_{min}})$$

where α is the adjusted parameter, we have taken it as 1, pdfmax is the maximum pdf of original histogram and pdfmin is the minimum pdf . The changed cdf is calculated by way of the use of weighted pdf

$$cdf_w(I) = \sum_{l=0}^{l_{max}} \frac{pdf_w(l)}{\sum pdf_w}$$

where the sum of pdf w is calculated as

$$\sum pdf_w = \sum_{l=0}^{l_{max}} pdf_w\ (l)$$

Finally, the adaptive gamma parameter is calculated on the foundation of equation

$$\Upsilon = 1 - cdfw(1)$$

Then this ϒ is used in transformation function

$$T(l) = l_{\max}(1/l_{max})$$

B. Contrast Limited Adaptive Histogram Equalization (CLAHE)

Firstly, the picture captured with the aid of the digital camera in foggy condition is converted from RGB (purple, inexperienced and blue) color area is converted to HSV (hue, saturation and value) coloration space. The pictures are transformed because the human feel colors in addition as HSV represent colorings. Secondly fee aspect is processed by CLAHE without effecting hue and saturation. This method use HE to a contextual area. The original histogram is cropped and the cropped pixels are redistributed to each gray-level. In this each pixel value is reduced to maxima of user selectable. Finally, the IP in HSV color space is converted lower back to RGB color area.[4].

C. Discrete Wavelet Transform (DWT)

DWT decomposes the input signal into four parts with the use of the translation and dilation property. An appropriate wavelet function is chosen for decomposing the image. The 2-D DWT decomposition may be completed by way of employing 1-D wavelet remodel first alongside the rows and then along the columns on the resultant. The picture is decomposed into 4 frequency bands and they are LL, LH, HL and HH.[2].

D. LPM(Laplacian pyramid)

A pyramid shape incorporates exceptional ranges of an unique picture. These stages are obtained recursively by means of filtering the lower level (LL) picture with a low-pass filter (LPF). We first make a Gaussian pyramid (GP) by way of filtering each stage of picture the usage of a LPF and do the down sampling. As the extent is going up, the picture is getting smaller and smaller. The equation to get an top stage of GP from a LL is as follows:[5].

$G_k = [\ \omega * G_{k-1}] \downarrow 2$

Where w is the low-pass filter we use.

E. Multiscale Retinex (MSR)

Because of the trade-off between dynamic range compression and color rendition, the choice of the right scale σ for the surround filter F(x, y) is crucial in Single Scale Retinex (5). Multiscale Retinex (MSR) seems to afford an acceptable trade-off between a good local dynamic range and a good color rendition. The MSR output is defined as a weighted sum of the outputs of several SSR. This led Jobson et al. [6] to propose the multiscale retinex formula

$$R_{MSRi} = \sum_{n=1}^{N} w_n R_{ni} = [\log I_i(x,y) - \log(F_n(x,y) * I_i(x,y))] \qquad (6)$$

where N is the number of scales, w_n is the weight of each scale and

$$F_n\ (x,y) = C_n\ exp\ [-(x^2 + y^2)/2\sigma_n^2]$$

The questions that immediately arise are: what scales to choose, and how many, and what are the ideal values for the weights. According to Jobson et al. three scales are enough for most images, and the weights can be identical. These authors experimentally fixed the scales to 15, 80 and 250.

F. Histogram Modification Framework (HMF)

Here we want to convert the picture so that it has a particular histogram that can be arbitrarily specified. Such a mapping characteristic may be determined in 3 steps:

1) Equalize the histogram of the input picture
2) Equalize the required histogram
3) Relate the two HE

Here are the unique steps of the algorithm: Step 1: Find histogram of input picture and discover its cumulative the HE mapping feature:[7]

$$H_x[j] = \sum_{i=0}^{j} h_x[i]$$

Step 2: Specify the favored histogram and find its cumulative the HE mapping feature:

$$H_x[j] = \sum_{i=0}^{j} h_x[i]$$

Step 3: Relate the 2 mapping above to build a research table for the overall mapping. Specifically, for each input degree i, discover an output level so that first-rate matches:

$$|H_x - H_z[j]| = min_k |H_x[i] - H_z[k]|$$

And then we setup a lookup entry lookup[i]=j

IV. PROPOSE WORK

A. Local Contrast Image Enhancement (LCIE)

For LCIE we will go to use local contrast stretching (LCS) method. In LCS method we will go to target on local feature of an image. For this type of a LCS method we will go to focus on particular area of an image where we want to perform LCIE. In unsharp overlaying, photograph is separated into additives, the low-frequency (LF) unsharp mask obtained with the aid of LPF of the image, and the high-frequency (HF) aspect acquired with the aid of subtracting the unsharp mask from the unique picture itself. The HF element is then amplified and delivered returned to the unsharp mask to shape an enhanced image. Local enhancement based algorithms only make level of pixels in the fixed region, but effectively reduce the impact of other regions, and greatly enhance the local details.

In past decades, wavelet transform (WT) has been widely employed in IP, which decomposes a picture into a multi-resolution sub band structure through a two-channel filter bank. The multi-resolution decomposition of the picture is formed by repeatedly implementing LPF, HPF and down-sampler to the picture in the Horizontal and vertical directions

The system of adjusting depth values can be accomplished automatically the use of HE. HE entails transforming the depth values so that the histogram of the output picture approximately matches a distinctive histogram. By default, the HE feature, histeq, tries to match a flat histogram with sixty four packing containers; however you can specify a distinct histogram alternatively.

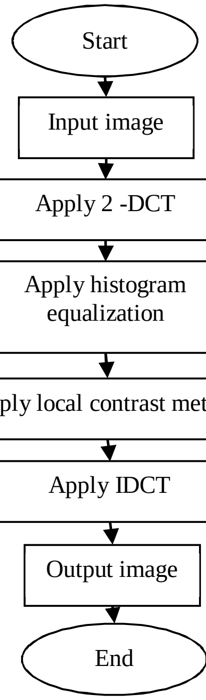

Fig. 1 flow chart on propose algorithm

In our proposed methodology, first of all a picture is given as input after that 2 –DCT is applied on it. Then HE is done on 2-DCT output then we apply LC method to it. At the end, finally we apply IDCT and generate the output.

V. RESULT ANALYSIS

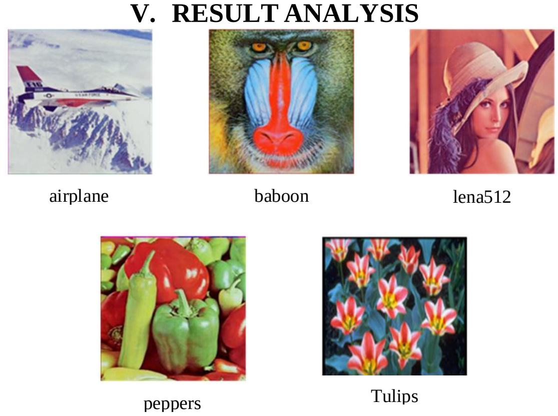

Fig. 2. Image dataset

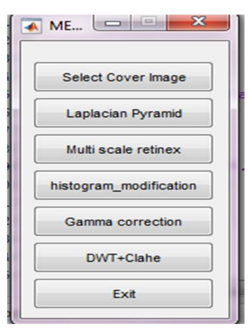

Fig. 3.GUI running process

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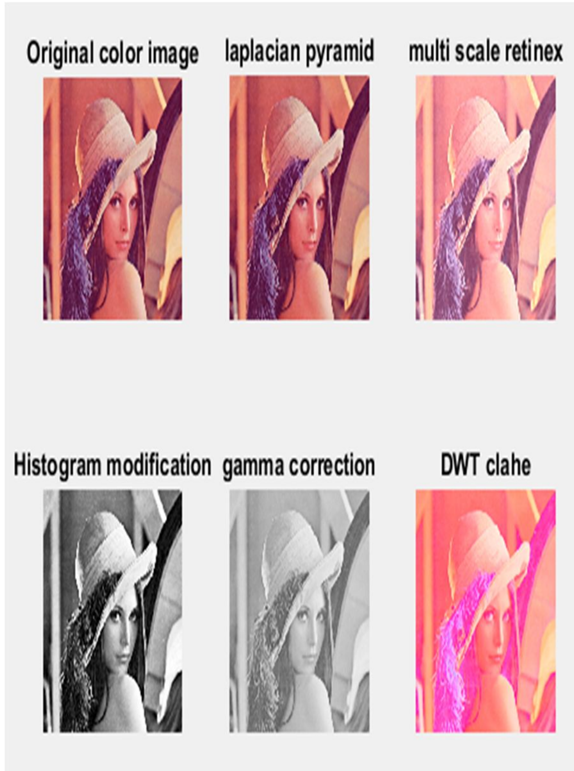

Fig. 3 show the all techniques effect for image

TABLE I. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR LAPLACIAN PYRAMID METHOD

Image	PSNR for Laplacian Pyramid	MAE for Laplacian Pyramid	Sigma for Laplacian Pyramid
airplane	2.7221	1.4466e-15	0.0069
baboon	5.7106	9.3153e-16	0.0460
lena512	5.1528	1.0118e-15	0.0108
peppers	5.9991	8.7489e-16	0.0060
Tulips	6.9075	7.1288e-16	0.0587

TABLE II. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR MULTI SCALE RETINEX METHOD

Image	PSNR for Multi scale retinex	MAE for Multi scale retinex	Sigma for Multi scale retinex
airplane	16.4880	3.2376	1.9004
baboon	14.4157	2.6737	11.3931
lena512	13.2770	3.8334	2.4951
peppers	13.4292	4.8363	1.6206
Tulips	13.6243	4.8372	13.3523

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TABLE III. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR HISTOGRAM MODIFICATION METHOD

Image	PSNR for histogram modification	MAE for histogram modification	Sigma for histogram modification
airplane	11.7403	54.5328	5.1494
baboon	18.2005	10.8851	19.9110
lena512	19.0640	11.2952	4.7415
peppers	20.4604	6.2574	2.9019
Tulips	15.9790		18.5891

TABLE IV. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR GAMMA CORRECTION METHOD

Image	PSNR for Gamma correction	MAE for Gamma correction	Sigma for Gamma correction
airplane	13.4292	2.6376	1.2315
baboon	12.2315	3.2626	9.1924
lena512	19.1924	1.6353	2.2147
peppers	15.8690	2.3634	1.3604
Tulips	14.4157	2.3838	15.8690

TABLE V. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR BASE METHOD METHOD

Image	PSNR for Base method	MAE for Base method	Sigma for Base method
airplane	12.8272	1.0033	0.0093
baboon	13.8263	0.7363	0.0120
lena512	14.7673	2.7363	0.0093
peppers	12.8342	1.2933	0.0113
Tulips	12.2272	0.8353	0.0285

TABLE VI. COMPARISON OF PSNR, MAE AND SIGMA VALUE FOR PROPOSED METHOD METHOD

Image	PSNR for Proposed method	MAE for Proposed method	Sigma for Proposed method
airplane	14.0365	0.8453	8.1780
baboon	15.8690	0.6351	7.0383
lena512	19.9110	0.5723	9.3763
peppers	13.4292	0.2353	8.7353
Tulips	14.4157	0.2543	3.8363

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VI. CONCLUSION

This paper deals with a manner of improving the great of underwater image (UI). The high-quality of UI is terrible due to the homes of water and its impurities. The residences of water purpose attenuation of mild travels through the water medium, resulting in low contrast, blur, inhomogeneous lighting fixtures, and color diminishing of the UI. This paper proposes a technique of enhancing the exceptional of UI. Ordinary HE uses the identical transformation derived from the picture histogram to convert all pixels. This works well while the distribution of pixel values is comparable all through the picture. However, when the picture incorporates areas which can be significantly lighter or darker than maximum of the picture, the contrast in the ones areas will no longer be sufficiently more advantageous. The goal is to decorate the UI contrast even as preserving image brightness. The proposed strategies were examined the use of numerous underwater images and offers higher visible nice PSNR and MSE price.

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