IJCTA, 9(23), 2016, pp. 11-18

Hybrid Binary Bat Optimization based Underwater Colour Image Enhancement

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Abstract : Image enhancement plays a vital role in vision dependent applications. The process of underwater image discovered is important as compared to bright nature because these underwater images produce certain critical difficulties. In this paper, a novel contrast development approach is shown for the improvement of underwater images. The planned method is centred on Hybrid binary bat optimization using DWT-SVD. The new improved hybrid binary bat optimization approach is utilized to achieve the adjustment factor for illumination improvement. In this approach, by utilizing DWT the first image is mainly split into four sub images. Thereafter, a singular value matrix of the LL sub image is assessed after that adjusts the image employing optimistic adjustment value. Then ultimately, the improved image is made through inverse DWT. The outcome achieved during this approach shows the planned method offers superior efficiency when compared with conventional method and retains the image illumination accurately and improves it with negligible visual items.

Keywords : Image Enhancement, DWT, SVD, Binary bat Optimization.

1. INTRODUCTION

Image enhancement approach is among the most used practices to improve the visual quality of the images. The key factor aim of image improvement is always to process the image therefore result is considerably improved in comparison to original image for a specific program (Randa Atta et al. 2015). In recent years, you can find always a wide range of experts on the development of image quality, but just restricted effort on underwater imaging. As we found the image underneath the water and or deep within the sea it get blurred subsequently of deprived visibility situation and blending of light and Denser medium of water etc. (SL, Wong et al. 2014). By using this few accomplish did to improve the condition of the underwater images. Locating clear and high contrast pictures in under the ocean executive is obviously a hard job nevertheless a vital matter in underwater engineering. These difficulties are hard to be managed, generally as a result of physical qualities of the water medium (SL, Wong et al. 2014). There are lots of image improvement strategies have already been proposed. Spatial Domain Methods are derived from direct treatment of pixel inside an image. Histogram Equalization methods are on the list of spatial domain image improvement techniques. Frequency domain methods are derived from adjusting the Fourier transform of an image (A.K. Bhandari et al. 2015).

The 2D DWT approach is one of the most popular frequency domain methods which first features DWT to split the actual image into four sub images namely LL, HL, LH, and HH. As, the LL sub image has light data and LH, HL, HH sub-band involves edge information. DWT approach reconstructs the improved picture with the Inverse Discrete Wavelet Transform (IDWT). By implementing 1-D wavelet transform firstly on rows and then on columns will help to execute 2-D wavelet transform which is shown in Fig 1(A.K Bhandari et al. (2014).

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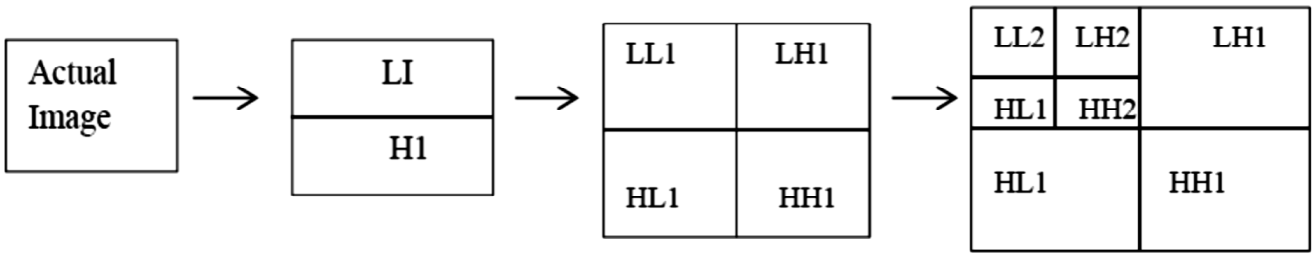


Fig. 1. 2D DWT decomposition into two levels.

To improve the illumination of the image, the SVD is applied on the low-low sub image. SVD is employed to control the light problem. SVD of an image is displayed as:

$$D = U_D \Sigma_D V_D^T \quad (1)$$

Wherever U_D and V_D are orthogonal matrices and the Σ_D matric specifies the grouped singular values on their main diagonal. The intensity of the image is presented in Singular value matrices and thus any improvements on the singular values may change the intensity of the input image (Hasan Demirel et al. 2010)

The binary bat algorithm has been simulated by the echolocation behaviour of bats. The faculties of bat for locating their prey are being used in binary bat algorithm. Bats often reduce the loudness and raise the rate of emitted ultrasonic sound, when they search prey. In binary bat algorithm each artificial bats have a position, velocity and frequency vector. The positioning in the binary bat is sometimes 0 or 1 (Selva Rani et al. 2015).

2. RELATED WORK

By using numerous methods many work has done in image enhancement. Specialists have recommended different ways and formulas for image enhancement.

Randa Atta et al. (2015) [1] proposed a alteration of the low contrast improvement strategies which are on the basis of the SVD that conserve the mean illumination of a specific image and improves it with fairly insignificant visible artifacts. SL, Wong (2014)[2] discussed a relative analysis for marine images centred on contrast stretching, HE and CLAHE in the RGB and HSV color areas and CLAHE provide better results as compared to other methods.

A.K. Bhandari et al. (2015) [3] discussed an improved strategy knee function and gamma correction using DWT–SVD for enhancement of remote sensing images and improves the overall contrast and visibility of local details better. A. Sylvia Selva Rani (2015) [4] proposed a novel process to pick subset of features from unlabelled information applying binary bat algorithm with amount of squared error since the fitness function.

A.K Bhandari (2014) [5] mentioned a approach to improve the low contrast satellite photographs that utilizes the ABC approach to study the variables of the adaptive thresholding function necessary for optimum improvement on the basis of the Artificial Bee Colony algorithm using DWT-SVD. Hasan Demirel et al. (2010) [6] mentioned an approach discrete wavelet transform (DWT) and single value decomposition for the progress of satellite images and preserves the light of the images precisely.

Li, Yi, et al. (2016) [7] planned an efficient advancement process predicated on atmospheric scattering and HE. Fresh benefits reveal that the efficiency as well as effectiveness of the planned algorithm is better, in comparison to other formulas. Furthermore, the planned method is qualified to improve infra-red image for various purposes. Boudhane et al. (2016) [8] discussed a technique for pre-processing as well as fish localization in marine photos predicated on a Poisson–Gauss theory, since it could effectively explain the noise contained in a big selection of imaging systems. In the preprocessing stage we denoise and reconstruct images. The technique is try out under various marine situations. Fresh benefits reveal that the planned method outperforms conventional methods.

Kanika et al (2015) [9] discussed a cross strategy which include integrated Mixed CLAHE with the LAB based fuzzy development to stop the matter of over-enhancement in Combine CLAHE for marine images. F Xue yang et al. (2015) [10] planned a regularized- HE and the DCT to improve the image quality of remote sensing images with better contrast and heavier facts.

Chen Hee Ooi et al. (2010)[11] discussed two contrast improvement and illumination keeping methods i.e dynamic quadrant HE plateau restrict (DQHEPL) and Bi-histogram Equalization Median Plateau Restrict (BHEPL-D). Both of the planned techniques may keep the mean illumination while keeping the essential factors of the picture and do not create any undesired items. JW, Wang et al. (2015) [12] proposed a solid algorithm for fingerprint image quality progress applying DWT and DCT. The planned algorithm probably increases the understanding and continuity in a fingerprint image.

3. PROPOSED ALGORITHM

3.1. Algorithmic Steps

This part consists planned algorithm's steps. It has presented the various measures which are essential to use the planned algorithm. The key huge difference here is by utilizing Binary bat Algorithm to obtain additional perfect benefits as within figure:

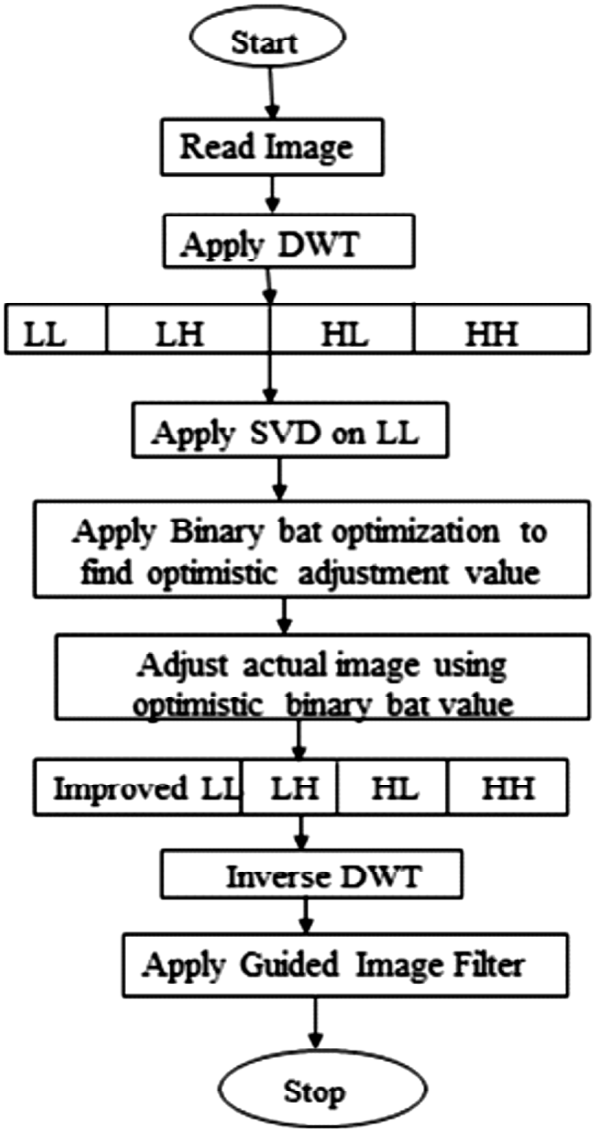


Fig. 2. Proposed Methodology Flowchart.

Stage 1 : Select image from pc storage.

Stage 2 : Use DWT that could split the input image to the four sub images LL, LH, HL, HH. LL sub-image involves luminance data and HL, HH; LH sub-band involves edge information.

Stage 3 : Estimates the SVD on the low-low sub-band image.

Stage 4 : Apply binary bat optimization on LL Sub image to have the ability to find optimistic adjustment value.

Stage 5 : Improve real image using optimistic binary bat optimization value to improve the LL Sub image.

Stage 6 : DWT approach restructures the improved image with the Inverse DWT.

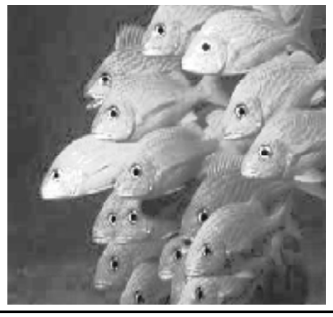
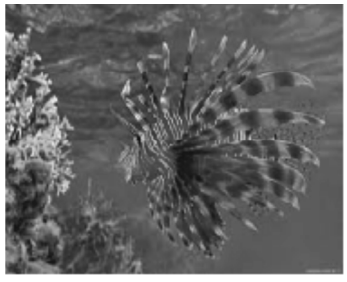
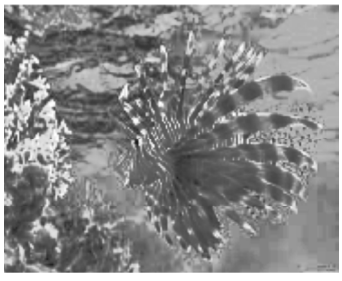
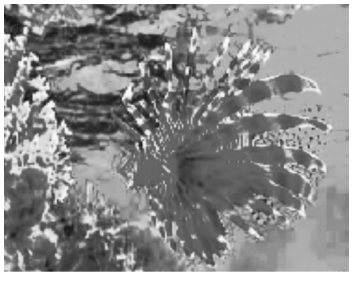
Stage 7 : Apply Guided image filtration which is used to protect edges.

Step 8 : The resultant image is the output image with improved method of enhancement.

4. EXPERIMENT AND RESULTS

To evaluate the efficiency of planned algorithm over existing method MATLAB tool is used .Table 1 is reveals the many underwater images from the various websites to carry out the experiment. These Underwater images from the various websites have been used to carry out the experiment whereas image 4 is taken from the paper entitled "Enriched Fuzzy and L* A* B based Mix Contrast Limited Adaptive Histogram Equalization." which gives better results when compared with DWT-SVD method.

Table 1. Enhancement Results on Images.

Images	*Original*	*Existing Technique*	*Proposed Technique*
1.			
2.			
3.			
4.			

Column 1 indicates the input image which can be transferred to the simulation. Column2 has shown contrast enhancement using DWT-SVD. Column 3 shows better results as compare to traditional method. Therefore the planned algorithm has shown really significant improvement around the conventional technique.

5. PERFORMANCE ANALYSIS

Both the present and the planned techniques have been determined centred on three parameters particularly PSNR, MSE as well as RMSE. These parameters will prove that the planned technique is better in performance when compared with existing.

Peak Signal to Noise Ratio (PSNR)

PSNR basically determines the value of an image. PSNR require to be increased; consequently our purpose is to improve PSNR. Table 3 and Figure 2 are obviously shown that PSNR is maximum inside our situation therefore planned algorithm offers better results.

$$PSNR = 10 \log_{10} \frac{(MAX)^2}{MSE}$$

Where maximum number of pixels in the image is 256.

Table 2. PSNR Evaluation Table.

Image No.	*Conventional Technique*	*Planned Technique*
1.	56.2745	66.1649
2.	54.8378	69.3744
3.	55.6849	63.5976
4.	57.0006	62.2035
5.	55.7799	63.6499
6.	55.4899	69.0379
7.	56.0016	65.7391
8.	55.1716	65.8622
9.	54.6750	68.0214
10.	55.0657	74.4572

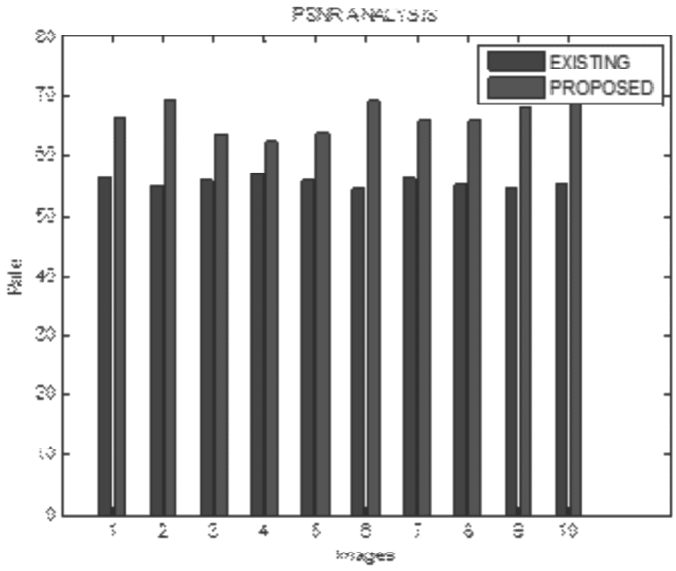


Fig. 3. PSNR Analysis for Existing and Proposed Technique.

Figure 3 has presented the examination of the PSNR on numerous imaginings by presented estimate suggested estimate in (Blue & Red lines). This is especially clear out from the graph that there is increase in PSNR values of images through the consumption of planned approach over previous techniques. This signifies advancement inside the quantitative property of the images.

Mean Square Error (MSE)

As MSE have to reduce; so our purpose is to reduce the MSE around possible. If MSE is less inside our situation thus proposed algorithm provides better benefits. MSE basically depicts how much an output image diverges from input image. It is basically a risk function.

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

Table 3. MSE evaluation table.

Image No.	*Conventional Technique*	*Planned Technique*
1.	0.1533	0.0157
2.	0.2135	0.0075
3.	0.1756	0.0284
4.	0.1297	0.0391
5.	0.1718	0.0281
6.	0.1837	0.0081
7.	0.1633	0.0173
8.	0.1977	0.0169
9.	0.2216	0.0103
10.	0.2025	0.0023

The above table indicates the appraisal of both the conventional and planned technique. Less the value of MSE, better the technique is.

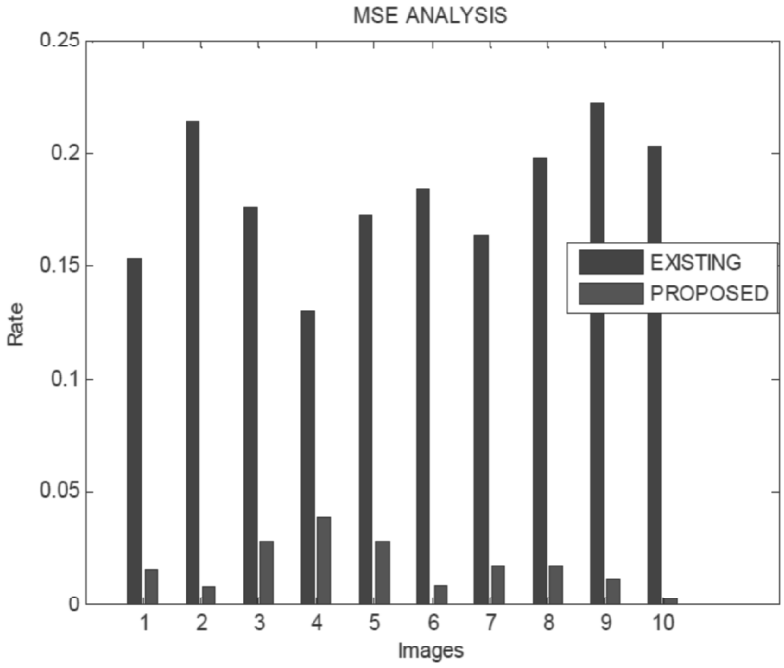


Fig. 4. MSE Analysis for Existing and Proposed Technique.

The above plot clearly shows that the MSE value for the proposed technique has decreased thereby proving that its better techniques than the existing.

Root Mean Square Error (RMSE)

Because of RMSE have to minimize; so our target is to reduce them RMSE around feasible. It is actually shown that RMSE is less in our event therefore planned algorithm offers greater results.

$$\text{RMSE} = \sqrt{\frac{1}{mn}\sum_{j=0}^{m-1}\sum_{k=0}^{n-1}[\text{I}(j,k) - \text{T}(\text{j},k)]^2}$$

Table 4. RMSE evaluation table.

Image No.	*Conventional Technique*	*Planned Technique*
1.	0.3916	0.1254
2.	0.4620	0.0867
3.	0.4191	0.1685
4.	0.3602	0.1979
5.	0.4145	0.1675
6.	0.4286	0.0901
7.	0.4041	0.1317
8.	0.4446	0.1298
9.	0.4707	0.1013
10.	0.4500	0.0483

The above table illustrates evaluation of both the conventional and planned method. Less the value of RMSE, better the technique is.

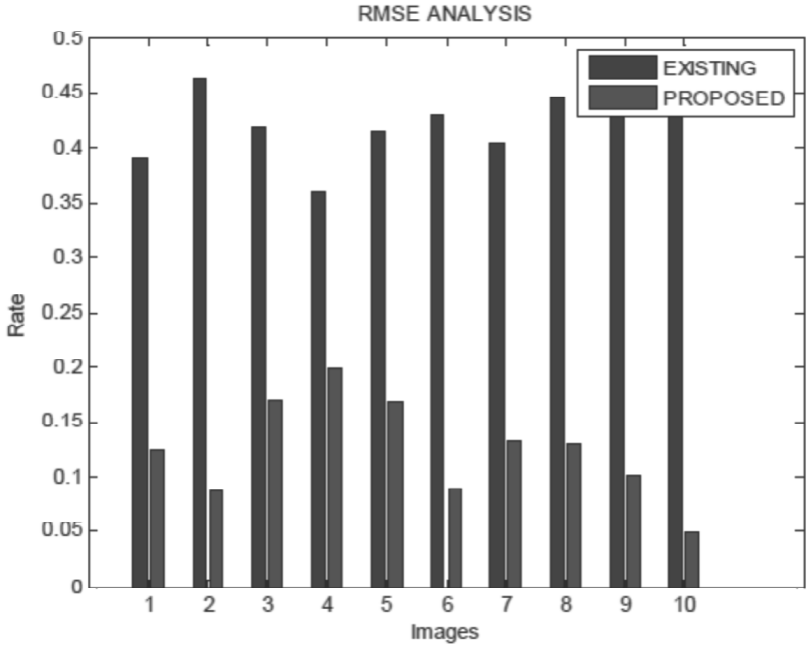


Fig. 5. RMSE Analysis for Existing and Proposed Technique.

The above plot clearly shows that the RMSE value for the proposed technique has decreased thereby proving that it is better techniques than the existing.

6. CONCLUSION

This paper has offered a novel algorithm which improves the visual quality of underwater images. In spite of the fact the SVD centred techniques update the low contrast images by scaling their singular value decomposition. The idea behind the proposed approach is quite simple and effective. Binary bat optimization has ability to find optimistic adjustment factor. Therefore provides more optimistic results. This paper has compared the proposed technique with the existing based upon the following parameters: Peak signal to noise ratio, Mean square error, and Root mean square error. The simulation outcome illustrates the proposed technique proves fairer outcomes than the conventional technique. This work has not considered the effect of the noise in images, thus in near future we will propose a hybrid technique by using proposed technique and some suitable filtering approach.

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