International Journal of Computer Applications (0975 – 8887)
Volume 115 – No. 2, April 2015

Enriched Fuzzy and L*A*B based Mix Contrast Limited Adaptive Histogram Equilization

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ABSTRACT
In this paper a novel algorithm has been designed to get rid of the problem of over-enhancement found in Mix CLAHE specifically for underwater images. The underwater image is suffering from low contrast and resolution because of dispossessed visibility circumstances, hence a subject identification become typical task. The processing of underwater image captured is important because the grade of underwater images distress and these images leads some serious problems in comparison with images from the clearer environment. This paper has proposed an hybrid approach which includes integrated the MIX-CLAHE with the L*A*B based fuzzy enhancement. The experimental results indicates that the proposed technique outperforms on the available methods.

Keywords
Mix CLAHE, L*A*B, Fuzzy logic, Underwater images.

1. INTRODUCTION
Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing `better' input for other automated image processing techniques. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified. The choice of attributes and the way they are modified are specific to a given task. Moreover, observer-specific factors, such as the human visual system and the observer's experience, will introduce a great deal of subjectivity into the choice of image enhancement methods. There exist many techniques that can enhance a digital image without spoiling it.

2. LITERATURE SURVEY
Asgharzadeh et al. (1994)[1] introduced Fuzzy logic rule based expert system capable of enhancing the grade of printed image. This really is achieved by using qualifiers in expressing the rule base to manage image attributes such as color, tint, contrast brightness, and sharpens. To develop the rule base system, a set of experiments are conducted to extract the information of the experts. This really is achieved by allowing each expert to obtain a set of prints for each image in a test set.From this result a set of quantified fuzzy IF-THEN rules are derived to increase score S over a big group of printed pictures. YoungSik Choi et al. (1995) [2] proposed a fuzzy rule-based approach to image enhancement to handle its seemingly conflicting goals: a) removing impulse noise, b) smoothing out non- impulse noise, and c) enhancing edges or certain other salient features. Three different filters for each task m derived using the weighted least mean squared method. Criteria for selecting each filter are defined. The overall results of the fuzzy rule-based system is computed because the mixture of the results of the in-patient filters, where each result contributes to their education that the corresponding antecedent clause is satisfied. This process gives us a strong and flexible image enhancement paradigm. Experimental email address details are presented. YoungSik Choi et al.(1997) [3] proposed a robust approach to image enhancement predicated on fuzzy logic that addresses the seemingly convicting goals of image enhancement are removing impulse noise, smoothing out non-impulse noise, and enhancing (or preserving) edges and certain other salient structures. They derived three different filters for all the above three tasks using the weighted (or fuzzy) least squares (LS) method, and define the criteria for selecting all the three filters. Thus results of the fuzzy rule-based system may be the mixture of the results of the in-patient filters, where each result contributes to their education that the corresponding antecedent clause is satisfied. Farzam Farbiz et al. (1998)[4] presented a brand new filtering approach based on fuzzy-logic that has high performance in mixed noise environments. This filter is principally on the basis of the proven fact that each pixel is not allowed to be uniformly fired by all the fuzzy rules. They performed several test experiments in order to highlight the merit of the proposed method. The results are very promising and indicating the high performance of the proposed filter in image restoration in compared with those of the filters that have been recently cited in image processing literature. Farzam Farbiz et al. (1998) [5] presented a brand new fuzzy-logic-control based filter with the properties of removing impulsive noise and smoothing out Gaussian noise while, preserving edges and image details efficiently. To attain the above mentioned three goals of image enhancement problem, they employed the concepts of fuzzy logic control to create a filter to perform all of the three tasks mentioned above. This filter is principally on the basis of the proven fact that each pixel is not allowed to be uniformly fired by all the fuzzy rules. To show how good their filtering approach works, several different cases of image enhancement problem have already been considered. M. B. Menhaj et al. (1999) [6] presented an expansion of previous fuzzy-logic based filtering approach whose high performance in mixed noise environments. This filter in addition has kept the typical property of not letting each pixel being uniformly fired all the fuzzy rules. It further aims at compressing the membership functions of fuzzy linguistic terms in each iteration to improve the filtering ability. They showed through some experiments how powerful their filter is in image enhancement. Cristian Munteanu et al. (2004) [6] introduced a brand new automatic image enhancement technique driven by an evolutionary optimization process. They proposed a story objective criterion for enhancement, and attempt finding the best image based on the respective criterion. Because of the high complexity of the enhancement criterion proposed, employ an evolutionary algorithm (EA) as an international search strategy to find the best enhancement. They compared their method with other automatic enhancement techniques, like contrast stretching and histogram equalization. Results obtained, both in terms of

subjective and objective evaluation. Yuichiro Tokuda et al. (2007) [7] created a graphic quality enhancement support system capable of reflecting user subjectivity. In this study, the derivation of an optimum gamma value is formulated being an optimization problem. To reflect user subjectivity, a graphic quality enhancement support system is realized by interactive evolutionary computation. This technique is verified by comparing it with a manually derived gamma value, image quality, and derivation time. Pourya Hoseini et.al (2010) [8] proposed a cross algorithm including Genetic Algorithm (GA), Ant Colony Optimization (ACO), and Simulated Annealing (SA) metaheuristics for increasing the contrast of images. This way, the contrast enhancement is obtained by globally transformation of the input intensities. ACO is used to generate the transfer functions which map the input intensities to the output intensities. SA as a local search method is utilized to change the transfer functions generated by ACO. GA gets the responsibility of evolutionary means of ants'characteristics. The outcome indicate that the brand new method performs better compared to previously presented methods from the subjective and objective viewpoints. Qingyun Yang et.al. (2010) [9] Tubbs proposed a regularized incomplete beta function to represent some nonlinear transform functions most commonly utilized in image contrast enhancement. But just how to define the coefficients of the beta function adaptively is still a problem. Applying the differential evolution in image contrast enhancement, they utilized the global quickly search ability of the differential evolution algorithm, adaptive mutation, search, at last searches the perfect α, β values of beta function and gets an adaptive contrast enhanced image. In order to avoid trapping into local optimum, a chaotic differential evolution algorithm is proposed. Experimental results reveal that the proposed algorithm can find the global optimal α, β in few iterations and save largely computational time and complexity Alexey Saenko et.al. (2012) [10] compared three different edge detection approaches which are derived from search, zero-crossing and fuzzy logic. One using fuzzy technique, was chosen for image enhancement and applied in a very specific field of optical measurements. Mohd. Farhan Khan et.al. (2012) [11] proposed a Multi-HE method for contrast enhancement of natural images while preserving its brightness and natural look. The proposed method decomposes the histogram of an input image into multiple segments, and then HE is put on each segment independently. Simulation results for all test images revealed that the proposed method enhances the contrast while preserving brightness and natural look of the images P .P. Sarangi et.al. (2014) [12] presented an effort to demonstrate its adaptability and effectiveness for searching global optimal methods to improve the contrast and detail in a gray scale image. The contrast enhancement of a picture is conducted by gray level modification using parameterized intensity transformation function that's considered as an objective function. The duty of DE is always to adapt the parameters of the transformation function by maximizing the objective fitness criterion. Experimental results were in contrast to other enhancement techniques, viz. histogram equalization, contrast stretching and particle swarm optimization (PSO) based image enhancement techniques. Senthilkumaran N et.al. (2014) [13] studied and compared different Techniques like Global Histogram Equalization (GHE), Local histogram equalization (LHE), Brightness preserving Dynamic Histogram equalization (BPDHE) and Adaptive Histogram Equalization (AHE) using different objective quality measures for MRI brain image Enhancement. Khan Wahid et al. (2014) [14] presented an efficient color image enhancement method for endoscopic images. The enhancement was achieved in two parts image enhancement at gray level followed by a color reproduction. The captured RGB endoscopic images are first changed into three 2-D spectral images using a well-known method called FICE (Fuji Intelligent Color Enhancement). Then a image with the maximum entropy is selected as the bottom image to be employed for color reproduction within the next stage. In color reproduction, the chrominance map of a source color image is put into the bottom image. This chrominance map is located by matching luminance and texture information between these two images predicated on neighborhood statistic method. The length between luminance the different parts of base gray image and source color images is calculated using 2-norm Euclidean distance. The proposed method highlights a few of the tissue characteristics in the bottom endoscopic image that'll enable better diagnosis. The performance of the scheme is weighed against other related algorithms with regards to simulation speed, image quality, efficiency of color reproduction and distortion. Yung-Tseng Chang et al. (2014) [15] employed the mean-variance analysis approach to partition the grey scale image into four sub images for individual image. A quad- histogram equalization technique has been proposed to improve the contrast of the palm bone X-ray radiographs. Experimental results using the proposed method indicated that their algorithm was better compared to global histogram equalization (GHE) technique and brightness preserving bi-histogram equalization (BBHE) technique. Anshita Aggarwal et.al. (2014) [16] proposed a technique predicated on image de-noising and edge enhancement of noisy multidimensional imaging data sets. For the intent of image denoising, Adaptive Multiscale Product Thresholding predicated on 2-D wavelet transform is used. In this method, contiguous wavelet sub bands are multiplied to enhance edge structure while reducing noise. In multi-scale products, boundaries could be successfully distinguished from noise. For the edge enhancement. Canny Edge Detection Algorithm is combined with scale multiplication technique. The proposed algorithm has been implemented using MATLAB. Simulation results for image enhancement were presented both for standard test images and CT scan image. Simulation a result demonstrates the planned technique better suppress the Poisson noise among several noises i.e. salt & pepper, speckle noise and random noise.

3. PROPOSED ALGORITHM

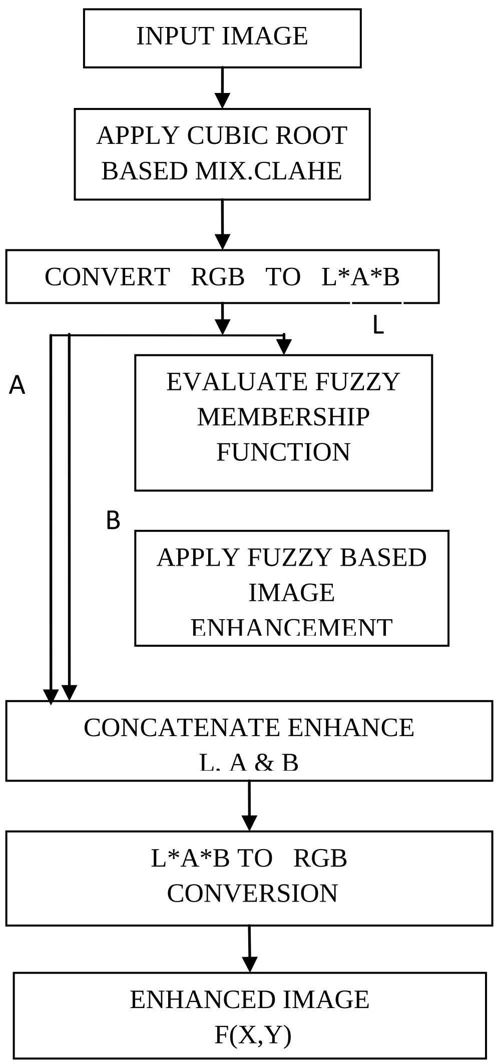

Figure 1: Proposed fuzzy based enhancement using L*a*b

Step 1: Select the image from computer memory in to computer program. Any given digital image is represented as an array size M*N pixels.

Step 2: Apply cubic root based method on given image which will reduce the number of bits in an image.

Step 3: Select the dimension size of an image in order to calculate the values of pixel in a current image which will also helps in obtaining end of file.

Step 4: Repeat the following steps until all the pixels of an image is not checked and end of file is not conquered.

Step 5: Collect all the pixels from mask following different size 3*3 , 5*5 , 7*7 in order to obtain pixels valued in selected mask

Step 6: Apply CLAHE to remove the haze from the images.

Step 7: Convert RGB to L*A*B color space

Step 8: Apply fuzzy based image enhancement on the L component of L*A*B color space to enhance the results further.

Step 9: Convert L*A*B to RGB color space

Step 10: Final image which has been visibly more stronger than the input image and the output of the available CLAHE results.

4. RESULTS AND DISCUSSIONS

The proposed algorithm is tested on various images. The algorithm is applied using two performance indices Normalized Absolute Error, Normalized Cross Correlation, Mean Difference and Average Difference

4.1 Experimental Set-Up

In order to implement the proposed algorithm, design and implementation has been done in MATLAB using image processing toolbox. Result showed that our proposed approach gives better results than the existing techniques.

a) Figure 2 has shown the input image which is passed to the simulation.

Figure 2: Input Image

Figure 3 has shown the output of previous filtering technique.

Figure 3: Filtered image

After applying proposed enhancement technique Figure 4 has shown the output results are quite effective and has much more better results than the available methods. Thus the proposed algorithm has shown quite significant improvement over the available methods.

Figure 4: Proposed enhancement method.

b)Figure 5 has shown the other input image which is passed to the simulation.

Figure 5: Input Image

Figure 6 has shown the output of previous filtering technique for figure 5.

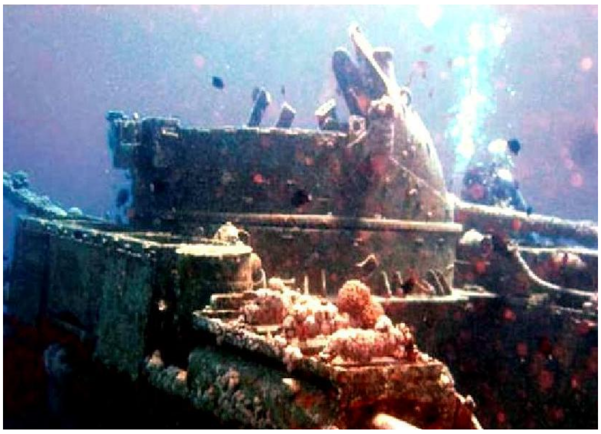

Figure 6: Filtered image

Figure 7: Proposed enhancement method.

After applying proposed enhancement technique Figure 7 has shown the output results for figure 5 are quite effective and has much more better results than the available methods. Thus the proposed algorithm has shown quite significant improvement over the available methods.

4.2 Performance Evaluation

This section contains the cross validation between existing and proposed techniques. Some well-known image performance parameters for digital images have been selected to prove that the performance of the proposed algorithm is quite better than the existing methods.

4.2.1 Normalized Cross Correlation

Table 1 is showing the comparative analysis of the Normalized Cross Correlation. As NCC need to be maximized; so the main goal is to increase the NCC as much as possible.

Table 1: NCC Evaluation

Images	Existing techniques	Proposed techniques
1	0.72	0.80
2	0.84	0.90
3	0.74	0.78
4	0.84	0.18
5	0.76	0.81
6	0.90	0.88
7	0.94	0.99
8	0.73	0.74
9	0.99	0.94
10	0.88	0.96

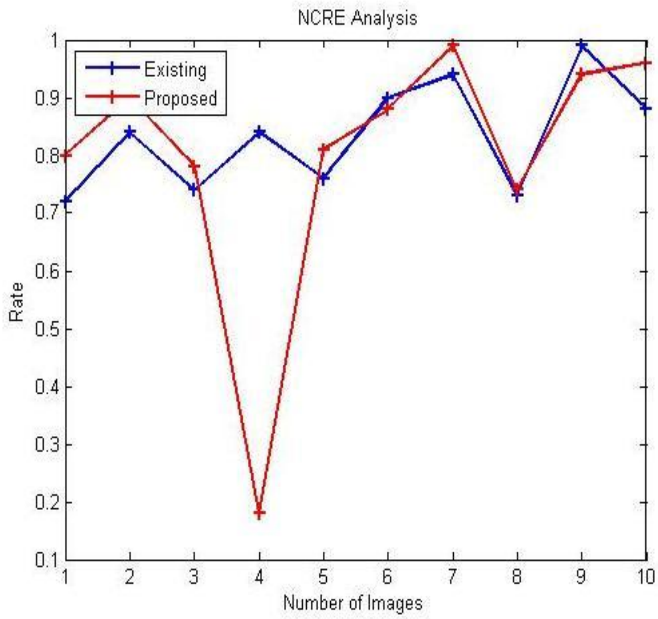

Figure 8: NCC Analysis

Table 1 has clearly shown that the NCC is maximum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the available methods. Figure 8 has shown the quantized analysis of the normalized cross corelation ratio of different images. It is very clear from the plot that there is increase in NCC value of images with the use of proposed method over other methods. This increase represents improvement in the objective quality of the image

4.2.2 Normalized Absolute Error

Table 2 is showing the quantized analysis of the normalized absolute error. As normalized absolute error need to be reduced therefore the proposed algorithm is showing the better results than the available methods as normalized absolute error is less in every case.

Table 2: NAE Evaluation

Images	Existing techniques	Proposed techniques
1	0.26	0.17
2	0.26	0.20
3	0.28	0.23
4	0.21	0.18
5	0.37	0.29
6	0.32	0.29
7	0.24	0.19
8	0.42	0.38
9	0.21	0.17
10	0.31	0.23

Figure 9 has shown the quantized analysis of the normalized absolute error of different images.

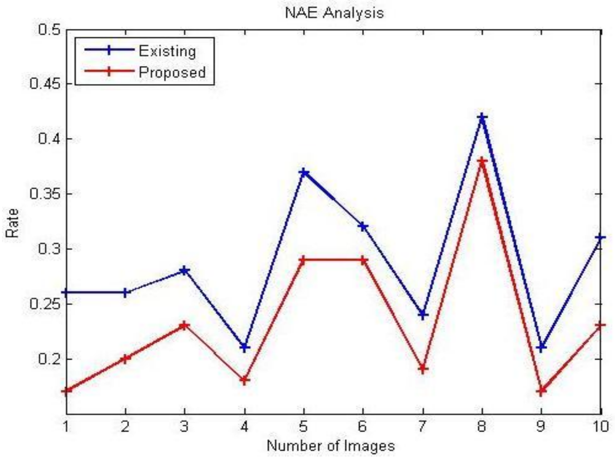

Figure 9: NAE Analysis

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

4.2.3 Average Difference

Table 3 is showing the quantized analysis of the Average Difference. As Average Difference need to be reduced therefore the proposed algorithm is showing the better results than the available methods as normalized absolute error is less in every case.

Table 3: AD Evaluation

Images	Existing techniques	Proposed techniques
1	1206.39	592.61
2	1054.78	660.20
3	6682.81	4933.47
4	3087.70	2685.25
5	1909.48	1243.70
6	3423.18	2793.16
7	1130.26	718.58
8	3139.90	2614.14
9	559.81	323.42
10	1631.23	938.53

Figure 10 has shown the quantized analysis of the Average Difference of different images.

4.2.4 Maximum Difference

Table 4 is showing the quantized analysis of the maximum difference. As maximum difference need to be reduced therefore the proposed algorithm is showing the better results than the available methods as maximum difference is less in every case.

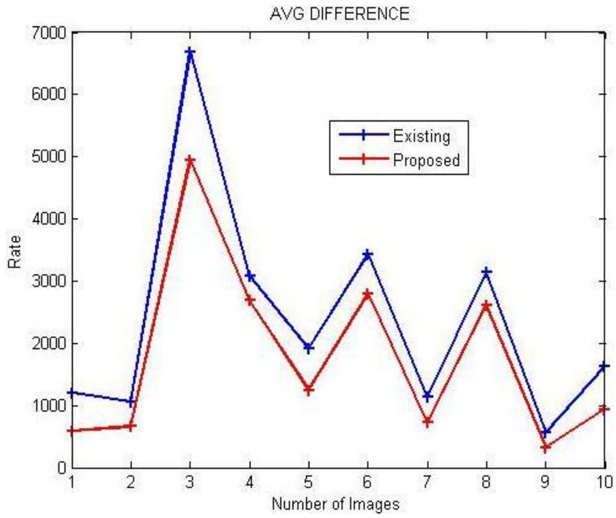

Figure 10: NAE Analysis

Table 4: MD Evaluation

Images	Existing techniques	Proposed techniques
1	20	8
2	42	33
3	180	162
4	127	119
5	47	44
6	118	105

7	54	47
8	74	64
9	36	29
10	56	29

Figure 11 has shown the quantized analysis of the maximum difference of different images.

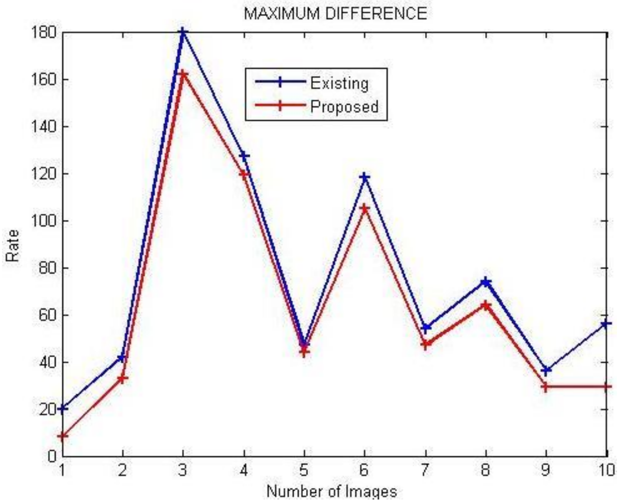

Figure 11: MD Analysis

5. CONCLUSION AND FUTURE SCOPE

This paper has proposed a fresh algorithm which includes removed the issue of over-enhancement within Mix CLAHE particularly for underwater images. The review analysis shows that the underwater image is suffering from low contrast and resolution as a result of dispossessed visibility circumstances, hence an item identification become typical task. This paper has offered an hybrid approach that has integrated the MIX-CLAHE with the L*A*B based fuzzy enhancement. The proposed technique has been designed and implemented in the MATLAB using image processing toolbox. The experimental results indicate that the proposed technique outperforms within the available methods.

However this work hasn't considered much quality assessment metrics, so in near future we use more quality metrics to judge the potency of the proposed technique.

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