ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.4

Low Contrast Color Images Enhancement Using Recursive Histogram Enhancement Algorithm

Mitika Saini[1], Kamal Kumar[2]
M.Tech Student[1], Assistant Professor & HOD[2]
Department of Computer Sciences
Swami Devi Dyal Institute of Engineering & Technology

Abstract:
The underwater images usually suffer from non-uniform lighting, low contrast, blur and diminished colors. In this document, we projected an image based preprocessing method to get better the superiority of the underwater images. Underwater image enhancement shows a vital role in marine trade. Underwater images are poor due to the properties of water and its impurity which results in many tribulations like low contrast, blur, color thinning *etc.* There exists many techniques that enhance the quality of such images but the images produced by them are either under enhanced or over enhanced. Comparative analysis shows that old method enhanced the images but not improved as much because of color noise but Proposed method enhanced the images in two steps first reduce the color noise by convolution and then iterative refine the images by total variation method. In this work a hybrid technique is proposed for better enhancement of underwater low exposure images. The proposed technique has two phases: image transformation and contrast stretching. The images obtained as output are much more natural and visually pleasing than the images obtained using the already existing techniques. The quantitative and qualitative results show that the proposed technique is superior to the already existing techniques.

I. INTRODUCTION

Underwater image is one of the methodical area of investigation for scientists. Underwater images are basically characterized by their unfortunate visibility because light is exponentially attenuated as it actions in the water, and the scenes result poorly contrasted and misty. Light attenuation restrict the visibility space at about twenty meters in apparent water and five meters or less in opaque water. The light reduction process is caused by assimilation and spreading, which persuade the overall presentation of underwater imaging system. Advance dispersion generally leads to haziness of the image features. On the other hand, backscattering generally confines the contrast of the images, producing a feature veil that superimpose itself on the image and hide the scene. Absorption and dispersion effects are not only due to the water itself but also due to the mechanism such as a dissolved organic matter.

The visibility array can be amplified with artificial enlightenment of light on the entity, but it produces non-consistent of light on the exterior of the object and generating a bright spot in the center of the image with badly illuminated region surrounding it. The sum of light is condensed when we go deeper, colors drop off depending on their wavelengths. The blur color actions across the longest in the water due to its undeviating wavelength. Underwater image suffer from partial range visibility, low contrast, non-uniform illumination, blurring, bright artifacts, color diminished and blare. The study on underwater image processing can be addressed from two dissimilar points of view such as an image re-establishment or an image augmentation technique. The image reinstatement targets to recover a tarnished image using a replica of the filth and of the unique image configuration; it is fundamentally an contrary problem. These techniques are precise, but they need many replica parameters like reduction and dispersion coefficients that distinguish the water turbidity and can be exceptionally variable. Whereas image enrichment uses qualitative subjective criterion to generate a more visually gratifying image and they do not depend on any corporeal model for the image structure. These types of approaches are usually simpler and quicker than deconvolution techniques. Recently, many scientists have developed preprocessing methods for underwater images using image augmentation techniques. Bazeille et al. [3] suggested an algorithm to pre-process underwater images. It decreases underwater perturbations and increases image superiority. In the last two decades, scientists have been aiming on increasing the superiority of underwater images. Major work has been done in two techniques: Image Color Correction and Image Enhancement to improve the quality of image. In Image Color Correction the RGB image is transformed into other formats such as YCbCr, HSV etc. and components are extracted for overall color correction. In Image Enhancement, Histogram equalization or histogram stretching are commonly used techniques. Histogram equalization improves the overall contrast of the image by flattening the probability distribution and stretching the dynamic range of grey levels but the original image cannot be restored[2], while histogram stretching increases the difference of maximum and minimum intensity values of an image and results in original image on restoration. This work makes use of the advantages of both the fields to create a hybrid approach for better enhancement of low exposure images.

The rest of the paper explains the related work done in this area and inspiration for proposed work, also shows the proposed algorithm and related flow chart. In last, proposed work results are shown along with the qualitative and quantitative assessment with existing results. Conclusion is done in final step.

II. EXISTING WORK

K. Singh *et al.* [1] anticipated two exposure based recursive histogram equalization techniques for image augmentation in which recursive separately method gives the finest resultant image. The technique used is called as state-of-the-art algorithm. The technique outperforms earlier HE based contrast improvement algorithms particularly for little light images. The major steps of the planned method of **Abdul ghani *et al.* [2]** are contrast and color alteration. The color of the image is also corrected to get better infiltration and intensity. In this study **Z.Ling *et al*. [3]** proposes an adaptive comprehensive piecewise histogram equalization algorithm (AEPHE) for shady image improvement. An adaptive histogram equalization, which balances amount conservation and contrast boosting, is further urbanized and in that order practical to these comprehensive piecewise histograms. The last histogram for image improvement is fashioned by a biased fusion of these equalized histograms.

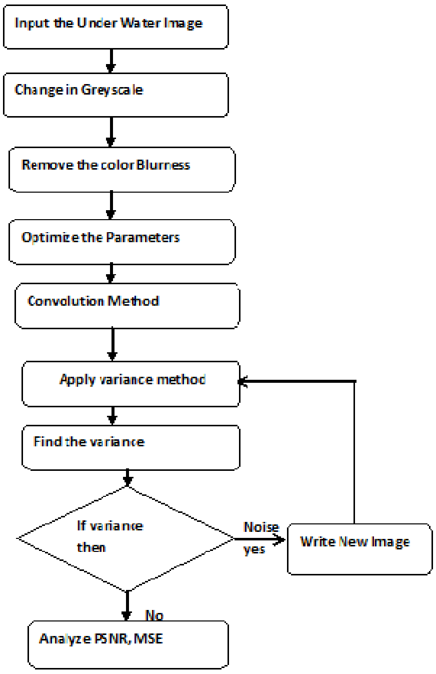
In this **S.C.F.Lin *et al*. [4]** improved Colorfulness via color channel stretching and contrast is improved by edge extension. Particularly, a hyperbolic-tangent function, whose scale is reliant on the unique image amount and detected edges, is constructed to correct the grow in roughness improvement. A compilation of natural images captured under deprived lighting circumstances are used in the examination adjacent to conservative and mask-based image enrichment approaches. **Weiji He *et al*. [5]** proposed a narrative infrared-to-visible image fusion algorithm for pleasing to the eye contrast and visibility. A multi-level technique based on the uniqueness of images and the properties of the targets is intended to absolute the image fusion procedure, where a contrast upgrading way is added in the low-frequency in sequence of the layered images and the edge information is improved in the high-frequency information using the correlation between the low- and high-frequency workings. In the experiment, three groups of infrared-to-noticeable images were used to reveal the efficiency of the multi-level union technique. All the assessment indexes, such as average deviation and information entropy, were considerably higher than other presented methods.

Yuecheng Li *et al*. [6] used the information of Human visual system (HVS) which has a influential natural means to optimize scene awareness in compound and unreliable illumination situation. He united the concept of admired Retinex and the histogram equalization (HE) and proposes an well-organized image genuineness improvement algorithm for both non-uniform and low light images. The algorithm focus the perceptual contrast while dropping halo artifacts, detail-clipping effects, and over-enhancements. An effort lightness is calculated based on the white-patch supposition. A Retinex based lightness correction is utilized to conserve and get better the contrast for bright areas. The halo artifacts are concealed based on Bilateral Filtering (BF).

III. PROPOSED TECHNIQUE

The study conducted by **Kuldeep*et al.*[4]** has a limitation that due to recursive clipping of histogram a lot of information in the image is lost. The technique proposed by **Ghani*et al.*[5]** enhances the under and over exposed area by determining the mid points of histogram but for images with more of the under exposed area, the technique performs very less enhancement. In this paper, a hybrid technique is proposed that overcomes these limitations and perform better enhancement using contrast stretching in a controllable manner.

3.1 Implementation of the Proposed TECHNIQUE



This section describes the proposed methodology steps and the working through the algorithm that is used in the proposed work.

Step 1: Input the underwater images.
Step 2: Change the input image into the grey scale.
Step 3: Remove the color blurness of the image.
Step 4: Optimize the parameters of the image.
Step 5: Apply the Convolution method after the optimization process.
Step 6: Compute the total variance method after the convolution.
Step 7: If variation is present then write new image otherwise calculate the PSNR and MSE.

Algorithm

Step 1: Categorizing the image (exposure value range between 1 and 0) by exposure threshold value. The image intensity exposure value equation is given below:

$$Exposure\_value = \frac{\sum_{k=0}^{L-1} h(k)*k}{L \sum_{k=0}^{L-1} h(k)} \quad (1)$$

where h(k) represents image's histogram and G represents the number of grey levels.

Step1.1: The exposure for the images that contain the majority of the low exposure region is in between 0 to 0.5. Whereas the exposure value of high exposed images is in between 0.5 to 1.

Step1.2: Parameter Xa is the grey level border value that divides the image into under revealed and over showing sub images.

$$Xa = G(1 - Exposure\_value) \quad (2)$$

Step 2: Calculating the global stretching:

$$Stretching = \frac{F(x,y) - min}{max - min} x255 \quad (3)$$

Step 2.1 According to exposure value, the stretching is done in controllable manner as stretch the 10% lower region towards the high intensity level and reduce the 10% higher region towards the low Intensity level

Stretching_under_exposed_area=$\frac{F(x,y)-10}{Exposure\ \_value\ -10} x255$ (4)

Stretching_Over_exposed_area=$\frac{F(x,y)-0}{max\ -0} x250$ (5)

Step 3: Equalizing the histogram value according to the exposure value. The histogram divided into two parts according to exposure value. The $P_L(k) and\ P_U(k)$ are the PDF of sub images.

$P_L(k)=\frac{h(k)}{N_L}$ for $0 \le k \le Xa-1$ (6)

$P_U(k)=\frac{h(k)}{Nu}$ for $Xa \le k \le L-1$ (7)

Step 3.1: Calculate CDF of sub Images from equations (6) and (7).

$$C_L(k) \sum_{K=0}^{X_a-1} P_L(k) \quad (8)$$

$$C_U(k) \sum_{K=Xa}^{L-1} P_{LU}(k) \quad (9)$$

IV.RESULTS AND DISCUSSION

IMAGE ENHANCEMENT

Table and graphs

Images Enhancement using old method

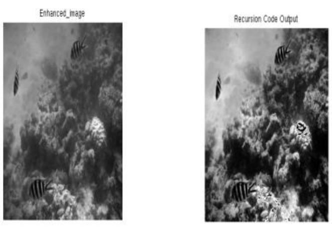


Figure 4.1: Image 2 enhancement by Old Method

In figure 4.1 shows the difference of image enhancement after histogram stretching. In this image still blurriness exists.

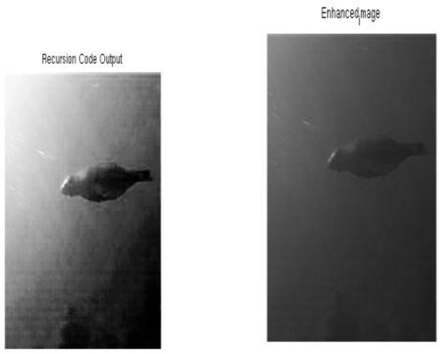


Figure 4.2 Images 3 by Old Method

In figure 4.2 and 4.3 show the difference of image enhancement after histogram stretching. In this image still blurriness exist because of unequalness of histogram.

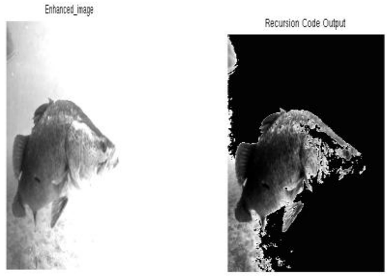


Figure 4.3 Images 4 by Old Method

Images Enhancement using new method

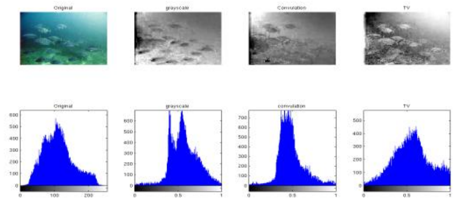
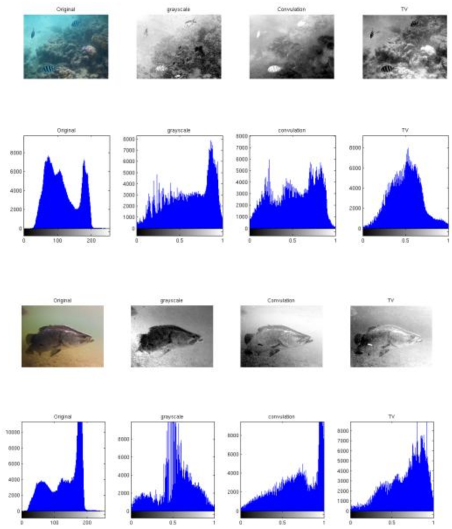


Figure 4.4: Underwater convolution with total variation

In figure 4.4 shows the histogram distribution change in difference enhancement changes by different distribution by different methods but blurriness level very low and MSE reduce.

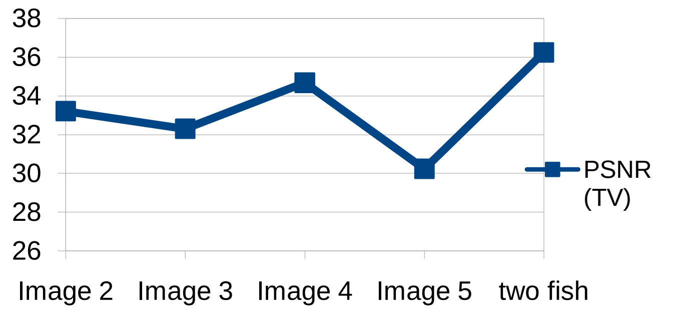


When analysis above given images then old method enhanced the images but not improve as much because of color noise but proposed method enhanced the images in two steps first reduce the color noise by convolution and then iterative refine the images by total variation method.

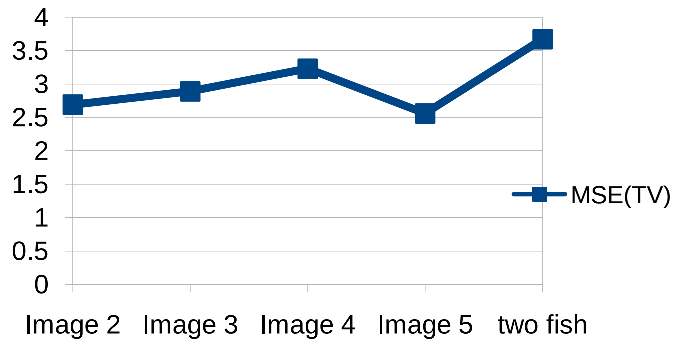
Table 4.1: PSNR and MSE with Total Variation

Images	PSNR(TV)	MSE(TV)
Image	33.209	2.6902
Image	32.3	3.23
Image	30.23	2.56
Two fish	36.23	3.67

Graph 2: Convolution with Total Variation



Graph 2.1: Graph showing different images PSNR using total variation

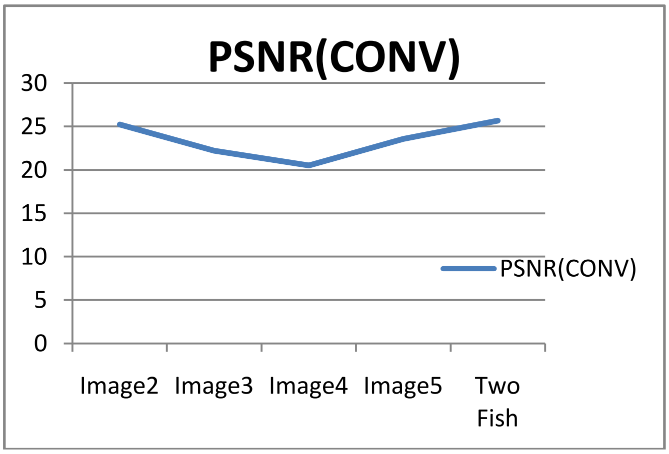


Graph 2.2: Graph showing different images MSE using total variation

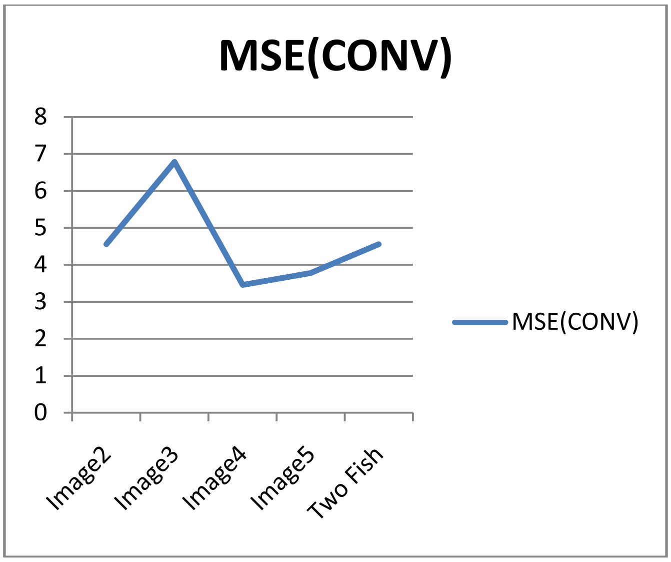
In above graph2.1 and 2.2 shows the variation in PSNR and MSE with total variation method

Table 5.2 PSNR and MSE with Total Variation

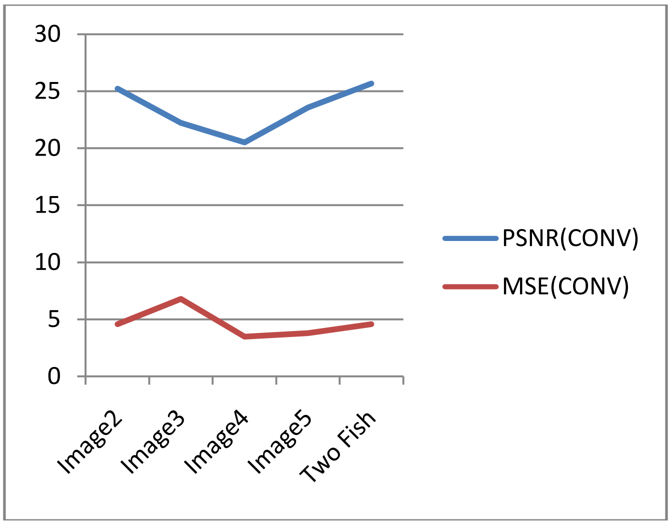
Images	PSNR(CONV)	MSE(CONV)
Image2	25.209	4.56
Image3	22.206	6.78
Image4	20.5	3.46
Image5	23.56	3.78
Two fish	25.67	4.56



Graph 2.3: Graph showing different images PSNR using convolution method.



Graph 2.4: Graph showing different images MSE using convolution method.

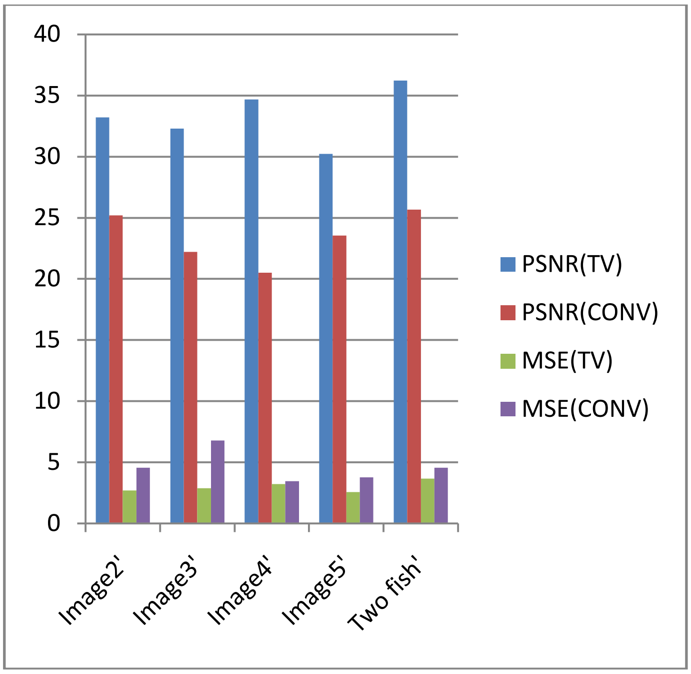


Graph 2.5: Graph showing different images MSE using convolution method.

Graph 2.5 shows that the value of PSNR is increased and values of MSE are deceased in convolution method**.**

Table 4.3: Comparison between total variation and convolution method

Images	PSNR (TV)	PSNR (CONV)	MSE (TV)	MSE (CONV)
Image2	33.209	25.209	2.6902	4.56
Image3	32.3	22.206	2.89	6.78
Image4	34.67	20.5	3.23	3.46
Image5	30.23	23.56	2.56	3.78
Two fish	36.23	25.67	3.67	4.56



Graph 2.6: Graph showing different images with both method on PSNR and MSE.

The underwater image processing area has conventional substantial notice within the last decades, screening important achievements. This paper has a analysis on some of the most recent methods that have been specifically developed for the underwater scenarios. These methods are capable of extending the range of underwater image processing, improving image contrast level and resolution quality. After consideration of the basic physics of the light propagation in the water medium, we focus on the different methods available in the previous articles. The situation for which all of them have been firstly developed are highlighted as well as the quality assessment methods used to evaluate their perform acne. The graph 2.6 shows that the value of PSNR is increased in by using convolution with total variation method. And MSE is reduced in this method as shown in graph.

CONCLUSION

In this work a hybrid technique is proposed for better enhancement of underwater low exposure images. The proposed technique has two phases: image transformation and contrast stretching. The images obtained as output are much more natural and visually pleasing than the images obtained using the already existing techniques. The quantitative and qualitative results show that the proposed technique is superior to the already existing techniques.

REFERENCES

[1] Kuldeep Singh, Rajeev Kapoor, and Sanjeev Kr. Sinha, “Enhancement of low exposure images via recursive histogram equalization algorithm”, Optik Journals, pp. 2619-2625, June 2015.

[2] Ahmad Shahrizan Abdul Ghani, Nor Ashidi Mat Isa, “Enhancement of low quality underwater images through integrated global and local contrast correction”, Applied Soft Computing Journal, pp. 332-344, August 2015.

[3] Zhigang Ling, Yan Liang,Yaonan Wang, He Shen, Xiao Lu, “Adaptive extended piecewise histogram equalization for dark image enhancement”, IET Journels,pp.1012-1019,May 2015.

[4] S.C.F. Lin, C.Y. Wong, G. Jiang, M.A. Rahman, T.R. Ren, Ngaiming Kwok, Haiyan Shi, Ying-Hao Yu, and Tonghai Wu “Intensity and edge based adaptive un-sharp masking filter for color image enhancement”, Optik Journals, pp. 407-414, August 2015

[5] Weiji He, Weiyi Feng, Yiyue Peng, Qian Chen, Guohua Gu, and Zhuang Miao, “Multi-level image fusion and enhancement for target detection”, Optik Journal, pp. 1203-1208, February 2015.

[6] Yuecheng Li, Hong Zhang, Wenyan Jia, Ding Yuan, Feiyang Cheng, Ruiming Jia, Lu Li ,and Mingui Sun, “Saliency guided naturalness enhancement in color images”, Optik Journals, pp. 1326-1334, July 2015.

[7] Shi Hong, Shan Fang-jian, Cong Bo and Qiu Wei, “An underwater ship fault detection method based on Sonar image processing”, ICAIT Journal of physics, March 2015.

[8] Ales Zamudaa, Jose Daniel Hernandez Sosab and Leonhard Adler, “Constrained differential evolution optimization for underwater gliderpath planning in sub-mesoscale eddy”, Elsevier Journals, pp. 93-118, Febraury 2016.

[9] Meng-Che Chuang, Jenq-Neng Hwang, and Kresimir Williams “A Feature Learning and Object Recognition Framework for Underwater Fish Images”, IEEE transactions on image processing, pp. 1862-1872, April 2016.

[10] Ebenezer Daniel, J. Anitha “Optimum green plane masking for the contrast enhancement of retinal images using enhanced genetic algorithm”, Optik Journals, pp. 1726-1730, May 2015.

[11] Yunxin Wang, Sha Guo, Dayong Wang, Qiaowen Lin, Lu Rong, Jie Zhao “Resolution enhancement phase-contrast imaging by microsphere digital holography”,Elsevier Journals, pp. 81-87, December 2015.

[12] Hoa-Tian Wu, Jiwu Huang,Yun-Qing Shi “A reversible data hiding method with contrast enhancement for medical images”, Elsevier Journals, pp. 146-153, June 2015.

[13] Shuhang Wang, Jin Zheng, Hai-Maio Hu, Bo Li “Naturalness preserved enhancement algorithm for non-uniform illumination images”, IEEE Transactions on image processing, pp. 3538-3548, September 2013.

[14] Karen Panetta, Chen Gao, Sos Agaian “No reference color image contrast and quality measures”, IEEE, pp. 643-651, September 2013.