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Novel Method: Image Enhancement Based on Dynamic Weighted Parameters

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Abstract: The primary aim of image augmentation is to process the image so the resulting image is much more useful than the real one for a particular application of computer vision. This research presents a new method of image enhancement which is based on the weight of dynamical pixels. Our proposed approach is easy to implement as well as other promising factors (weighted localization). This research proposed a Template Image Restoration Mask. This one is specially designed for dark images to remove darkness from images and the resultant image will be more suitable for computer vision applications. Several examples of Human, Animal, Food, and flowers will be provided to clearly show the performance of the proposed approach. This research helps to improve low quality images into high quality security perspectives and computer vision.

Keywords: Weighted pel; Image Enhancement; Dynamic parameter Filter; Image Mask.

1. Introduction

Enhancement of images is basically the procedure of strengthening the perception or interpretability of info in an image for better visualization. The primary goal of enhancement of images is to change the features of images to make them suitable for specific task or observer. Enhancement of colour images is absolutely essential in digital image processing [1]. Optimization of images is process of transforming digital images in order to improve the graphic data, which is considered as primary task by practically all tasks of image processing in areas like analysis of biomedical images, computer vision and others [2]. Goal of image enhancement is to just become better details and illustrate valuable data in an image. When a person takes a photograph with a digital photographic camera, the brightness, such as a sunlight, or a fluorescent lamp in a room degrades the image, leaving an uneven and uncontrollable excessively darker brighter region in the image [3]. Recent researches are grounded on an application of the algorithm of Kalman filtering [4] or Bayesian estimation extended to two-dimensional arrays resulted in the perception of a recursive filtering algorithm [5], [6].

In this paper an image enhancement technique called Image Restoration Mask (IRM) is proposed for the sharpening and enhancement of digital image. By using this method, we can improve the quality of the respective image. This filter specially designed for dark images to remove darkness from images and resultant image will more suitable for computer vision application. Several examples of Human, Animal, Food, and flowers will be provided to clearly show the performance of proposed approach. This research helps to improve low quality image into high quality security prospective and computer vision. The complete paper organize as follows, Section 2 describes the relevant work to fingerprint verification and blood circulation detection. The methodology of our work is described in section 3 and detail about proposed system also explains in this section. Experimental results also discussed in this section.

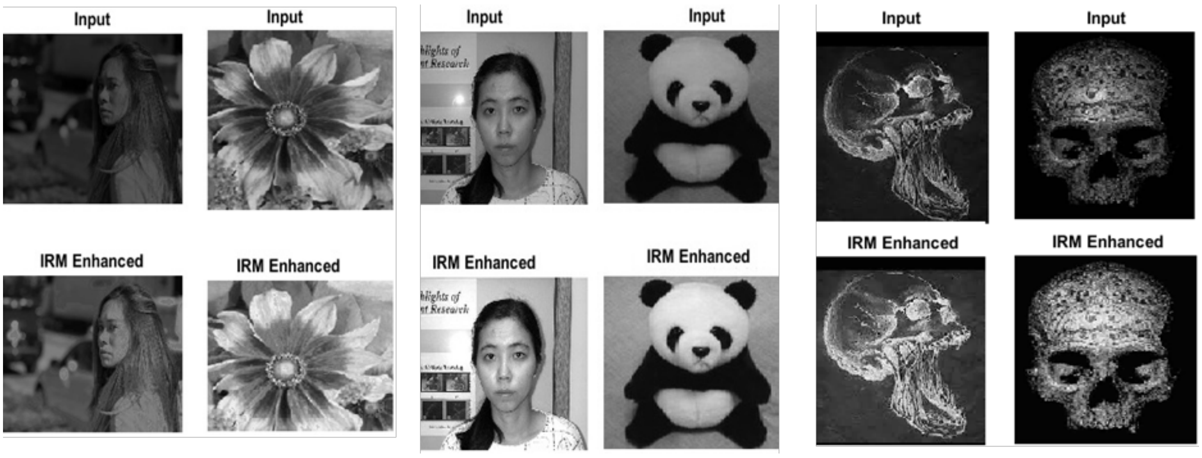

Figure 1. Shows the input and output images respectively on different types of objects (Humans, Flower, Toys and Medical images).

2. Literature Review

To investigate the relationships between Histogram Equalization basics and contrast, Ahmed M. Mahmoud (2012) disassembled equalization of Histogram into component blocks. Analyzing this, he concluded that we can acquire deviations in compactness but not in contrast of images using Histogram Equalization [7]. Xuelong Li (2014) developed a draw technique to detect control in digital images through contrast enhancement [8]. H. D. Cheng (2012) explored and examined the cause of over-amelioration. Results of the experiments clearly reveal that the suggested strategy is superior for vigorously monitoring values of entered pictures [9]. Xiaoming Chen (2013) Projected picture improvement approach based on Histogram Equalization using multi-scale un-sharpness mask-based methods. Overall contrast enhancement is achieved with HEBM, while local multi-scale contrast enhancement is achieved with UMBM.

This algorithm's output clearly demonstrates good global and local contrast enhancement, as well as noise and artefact suppression [10]. Gholamreza Anbarjafari, Demirel, Hasan, CagriOzcinar, and Demirel. (2010) For satellite photos, a method of image contrast augmentation based on Discrete Wavelet Transform & Singular Value Decomposition was proposed. DWT splits images into sub-bands of four frequencies, with the low sub-band image's singular value matrix twisted and also the images are reassembled using Inverse Discrete Wavelet Transform (IDWT) [11]. G. Maragatham, S. MdMansoor Roomi, and T. Manoj Prabu. Maragatham, S. MdMansoor Roomi, and T. Manoj Prabu (2011) They offer a method that employs Equalization of histogram to detect the background and foreground pixels of a picture and then applies bi-histogram equalization to them. Results suggested that his technique reserves original image as compared with other methods [12]. Arya et al. (2014) suggested a 2D-DWT technique which is excellent at distinguishing between image noise and high frequency components. The approach may not maintain the average brightness level due to the likelihood of large differences in pixel intensity values. It could be either over or under saturated [13].

Turgay Celik (2009) suggested a technique for breaking down input images into numerous frequency sub-bands using the Dual Tree Complex Wavelet Transform. The resultant image is approximated high-resolution and rebuilt by using a low-resolution image. The HF sub-band is zero-padded, and the product image is created by using Inverse Complex Wavelet Transform [14]. Hasan Demirel (2011) suggested a technique for improving image resolution. The input image is split into different frequency based sub-bands using the DWT. The supplied low-resolution images are interposed with top frequency sub-band images. All of these images are blended using the IDWT to produce enhanced resolute image [15]. According to Ke, Wei-Ming (2010), there are numerous techniques related to image enhancement that can be employed to advance an image's visual look. The algorithm he proposes consists of an image improvement context that associates two techniques: A technique of bilateral tone adjustment and a strategy for enhancing key scenes in mid-tone areas. Technique which depends on salience biased enhancement of contrast syndicates the idea of picture saliency, or the ability to be noticed, with a simple contrast enhancement technique which may be filter based. This technique boosts the areas that individuals may believe to be more important. [16].

As per the Ritu Chauhan (2011) Equalization of histogram is supposed as a method that is commonly used to improve contrast; however, it does have certain drawbacks. The Histogram Equalization approach recovers an image's inconsistency. It changes the pixel's intensity level. When associated to the technique of histogram equalization, brightness preserving weight clustering histogram equalization produces better results. The HE approaches for preserving of brightness weight clustering can safeguard and improve an image's illumination and graphic attractiveness. [17] A nonlinear colour picture improvement technique was suggested by Grimier, Deepak, and Joon whoan Lee (2011). Any technique is used to improve the image's attributes and visual look. He only enhanced the v mechanism like luminance value of colour image's HSV components. He believes that the H and S components do not require modification. The use of a nonlinear transfer function raises the luminance value. The function splits v element into blocks which are small and also overlapped, and luminance enhancement is performed for each pixel within the block. It is then enhanced in terms of contrast. Finally, the H, S, and V components are rehabilitated back to RGB images. [18].

Josephus, (2011) shown that Adaptive Histogram Equalization is the most effective and effective method for determining relevance of local information. However, information can be lost, causing problems with amplification and perhaps introducing speckle noise. In this case, limited adaptive histogram equalizations was applied, as well as a combination of frost and median filters. The frost filter technique [19] is used to eradicate speckle noise from an image. As per the work published in 2010, Gholamreza & Anbar Jafari proposed a CWT based technique of image processing. DT-CWT produces different sub band images utilizing the original image and two complex valued low frequency sub band images and six complex valued high frequency sub band images using CWT. Along with the low frequency image, the high frequency sub band image is interpolated. The IDT-CWT operation uses these real-valued pictures. This significantly increases the input image's quality and PSNR, resulting in a super-resolved output image [20]. P. Janani (2015) described about negative image enhancement, Log and power law techniques. These techniques work on thresh holding values [21].

3. Image Restoration Mask

As a shown Figure 1, our image enhancement technique increases sharpness, to improve quality of noisy image, our approach first applies a mask on input image, that mask remove the darkness and balance the values of input image on specific pixel.

Table 1. Shows the values of states

State	L=Pixels' Value Limit	w_p= Weighted
S_1	0-35	1.9
S_2	36-70	1.8
S_3	71-105	1.6
S_4	106-135	1.5
S_5	136-170	1.4
S_6	171-205	1.1
S_7	206-240	0.8
S_8	241-255	0.7

Considered the spectrum of existing darkness removal, these techniques removed the darkness in effective way, but our proposed approach based on gray level values. In proposed approach color image convert into gray level image [22] and then apply filter on them. The conversion has followed the mathematical notation [1].

I(x,y)=0.333F_r+0.5F_g+0.1666F_b (1)

Here Fr, Fg and Fb are the intensity of R, G and component respectively and I is the intensity of equivalent gray level image to RGB image. After conversion IRM apply on image using Eqs (2), (3). Mathematically, to account for the above observation, we proposed to express the compensated at every pixel location as follow.

$$H_{ij}=G_{max}/(Z_{max}-Z_{min})+I(x,y)\times C \tag{2}$$

Where H and I are input and output image respectively, G_{max} is maximum intensity of gray level, Z_{max} is maximum weight of input image, Z_{min} is minimum weight of input image, C is constant value (1.1).

$$H_{ij}^{l}=H_{ij}\times w_p \tag{3}$$

Where {p=1,2,3,4,5,6,7,8}
{i=1,2, 3……….m}
{j=1,2, 3………...n}

Here H^l is the enhanced resulted Image. Gray scale image has pixel values limit is 0 to 255, this limit is divided into eight sub range (8-states) shown in table 3, and every state area has different color intensity. The detail computation of Eq (3) as follow in computed weighted parameter of image section.

3.1. Computation Detail of Weighted Parameters:

$$\boldsymbol{H_{ij}^{l}} = \begin{cases} H_{ij}\times w_1 & if\ L \le s_1 \\ H_{ij}\times w_2 & if\ L \le s_2 \\ H_{ij}\times w_3 & if\ L \le s_3 \\ H_{ij}\times w_4 & if\ L \le s_4 \\ H_{ij}\times w_5 & if\ L \le s_5 \\ H_{ij}\times w_6 & if\ L \le s_6 \\ H_{ij}\times w_7 & if\ L \le s_7 \\ H_{ij}\times w_8 & if\ L \le s_8 \end{cases}.$$

State 1: The first state pixel value range 0 to 35, the value of W is automatically set 1.9.
State 2: The second state pixel value range 36 to 70, the value of W is automatically set 1.8.
State 3: The third state pixel value range 71 to 105, the value of W is automatically set 1.6.
State 4: The fourth state pixel value range 106 to 135, the value of W is automatically set 1.5.
State 5: The fifth state pixel value range is 136-170, the value of W is automatically set 1.4.
State 6: The sixth state pixel value from 171 to 205, the value of W is automatically set 1.1.
State 7: The seventh state pixel value range 206 to 240, the value of W is automatically set 0.8.
State 8: The eighth state pixel value from 241 to 255, the value of W is automatically set 0.7.

4. Experimental Results

This section presents the output of experiments on applying our proposed algorithm in various images compare its output with several existing Image Enhancements techniques. The performance of our proposed algorithm compared with Power law image Enhancement Technique, Linear Function Image Enhancement technique and Logarithm Image Enhancement technique. For comparison of results we used in Histogram, Image values and visual inspection to compare the performance with existing technique.

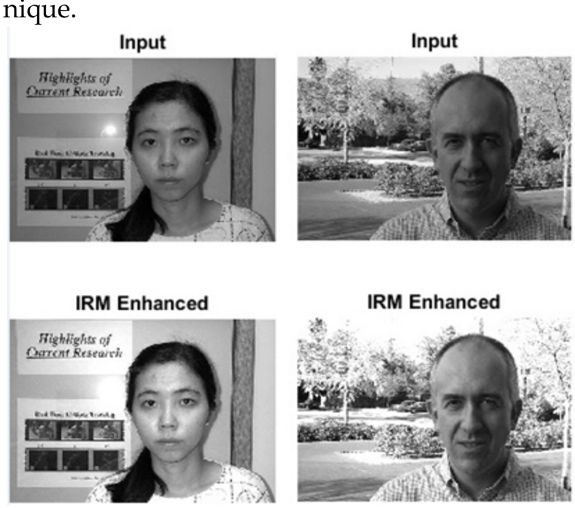

Figure 2. Shows the input and resulted images of Humans.

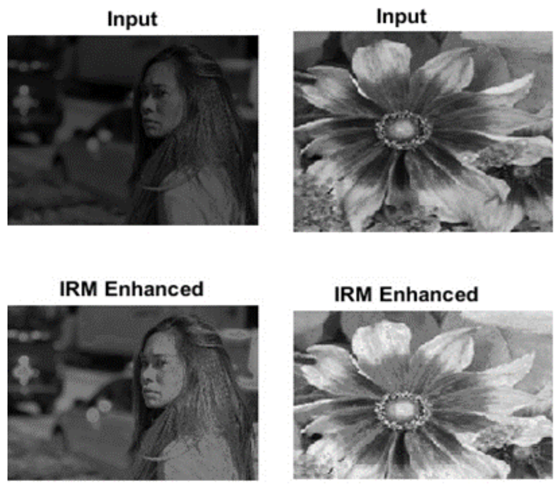

Figure 3. Shows the input and resulted images human and flowers.

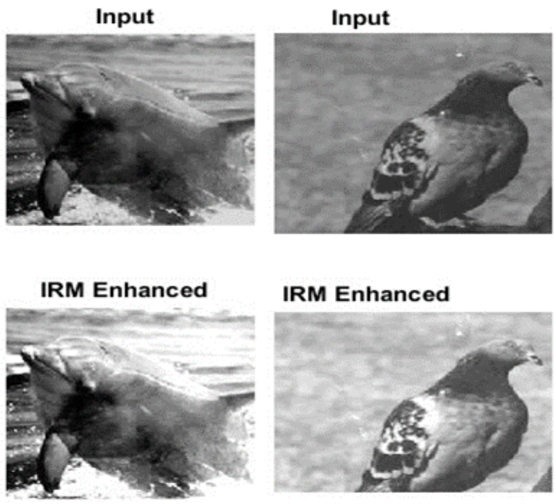

Figure 4. Shows the input and resulted images of animals & Birds.

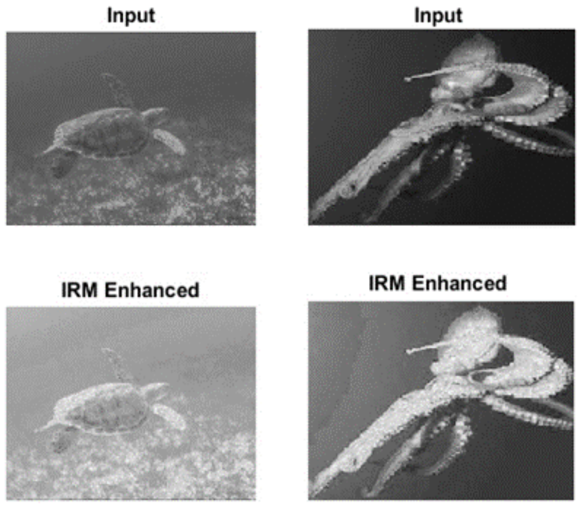

Figure 5. Shows the input and resulted images of Sea Animals.

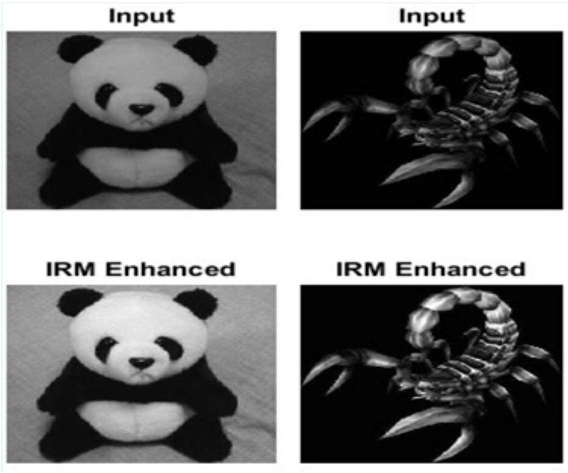

Figure 6. Shows the input and resulted images of Toys.

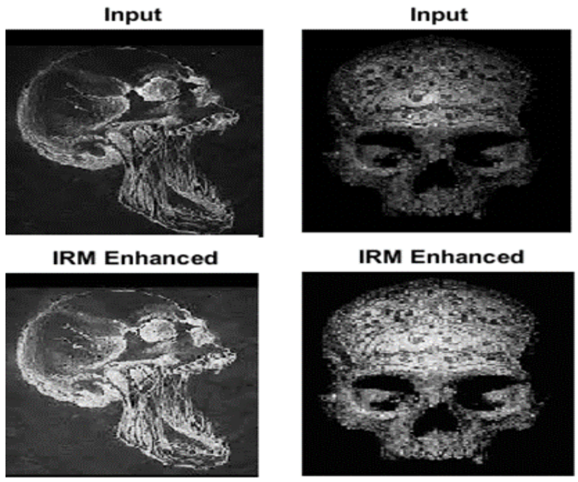

Figure 7. Shows the input and resulted images of medical domain

4.1 Experiment in MATLAB

We use Matlab 2017, Core i3, Windows OS 10, 6 GB RAM to test the proposed algorithm with existing techniques. We apply different Image Enhancement technique on 396*396 images shown in Fig 2 to 7, the color input image, first convert into gray scale image and then apply different technique in same environment.

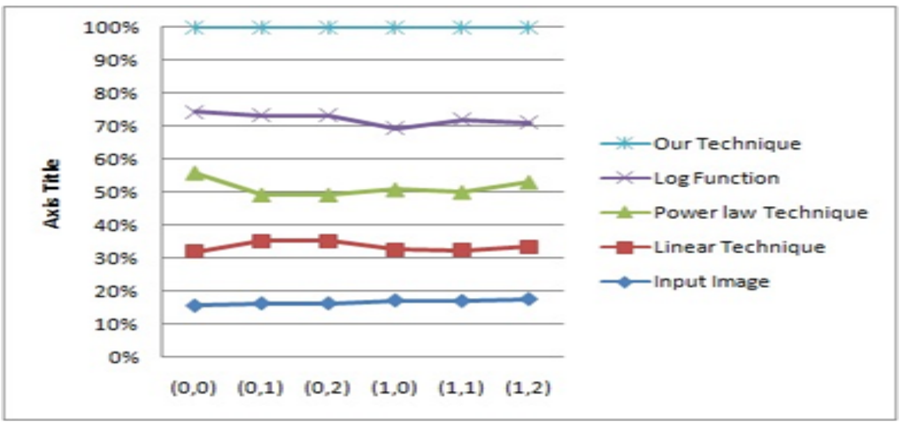

Figure 8. Shows the comparison of input image and result of different image enhancement techniques with our Technique in the form of graph.

Table 2. Shows the comparison values of input image pixels and result of different image enhancement techniques with our Technique.

Pixel Loc.	Input Image	Linear Technique	Power Law Technique	Log Function	Our Technique
(0,0)	131	139	200	157	216
(0,1)	129	150	112	190	212
(0,2)	129	150	112	190	212
(1,0)	102	92	108	110	182
(1,1)	109	98	114	140	180
(1,2)	125	113	139	128	206

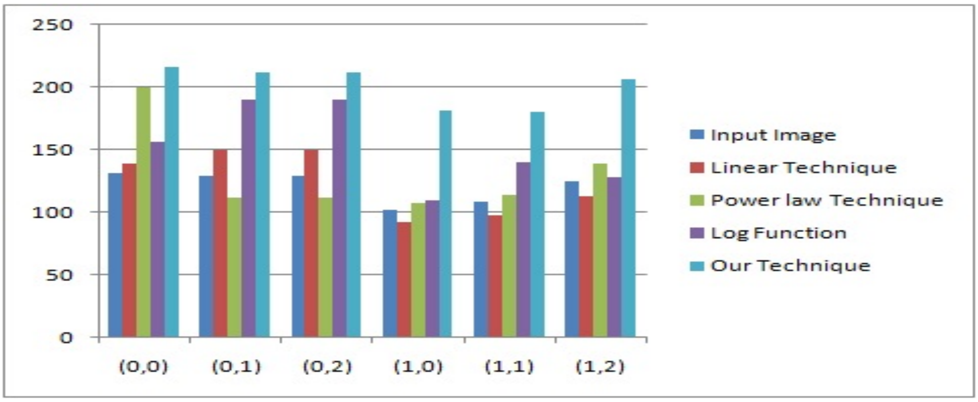

Figure 9. Shows the comparison of input image and result of different image enhancement techniques with our Technique in the form graph.

We apply proposed algorithm on different dataset image and acquire enhanced results that show that our proposed technique works better than existing techniques. The compression results also shown in table 3.8 that clearly shows the IRM balance the value of image matrix, existing techniques also enhanced the values of image but not focus on balance of value. The proposed work enhanced the image as well as balances the value, which leads the results in better way.

5. Conclusion

We have presented a new approach of image enhancement. Our strategy builds on gray level weight of image, which alter the values of input image and produced enhance image for better decision in every field. We have shown in our experiments our approach is able to enhance dark image in effective rather than existing techniques. Moreover, our proposed technique is enhanced image that are taken by low quality camera and satellite image and remove darkness form that low quality image for several challenging computer vision applications.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Youhei Terai, Tomio Goto “Color Image Enhancement” Proceedings of IEEE, pp-392-393, Iligan City, 2009.
2. Zhengya Xu, Hong Ren, Xinghuo “Color Image Enhancement by Virtual Histogram Approach” IEEE journal consumer electronics, vol.-56, NO. 2, may 2010, pp.204-208.
3. D. S. Turaga, Y. Chen, and J. Caviedes, “No reference PSNR estimation for compressed pictures,” Signal Process. Image Commun., vol. 19, pp.173–184, 2004
4. N. Wiener, Cybernetics, 2nd ed. Cambridge, MA: MIT Press, 1962; see also The Human Use of Human Being, 2nd ed. Boston, MA: Houghton Mifflin, 1956.
5. S. Watanabe, "The cybernetical view of time," in Progress in Bio cybernetics, vol. 3, Wiener and Schade, Eds. Amsterdam, The Netherlands: Elsevier, 1966; see also "Nobert Wiener and cybernetical concept of time," IEEE Trans. Syst., Man, Cybern., p. 372, May 1975.
6. P. Glansdorff and I. Prigogine, Thermodynamical Theory of Structure, Stability and Fluctuation. New York: Wiley, 1971.
7. Ahmed M. Mahmood, and Jasni Mohmad Zain. “A study on the validation of histogram equalization as a contrast enhancement technique”. In Advanced Computer Science Applications and Technologies (ACSAT),2012 International Conference on, pp.253-256.IEEE,2012.
8. Cao, Gang, Yao Zhao, Rongrong Ni, and Xuelong Li. "Contrast enhancement-based forensics in digital images." Information-Forensics and Security, IEEE Transactions on 9, no. 3 (2014): 515-525.
9. Cheng, H. D., and Yingtao Zhang. "Detecting of contrastover-enhancement." In Image Processing (ICIP), 2012 19th IEEE International Conference on, pp. 961-964. IEEE, 2012.
10. Chen, Xiaoming, and Lili Lv. "A Compositive Contrast Enhancement Algorithm of IR Image." In Information Technology and Applications (ITA), 2013 International Conference on, pp. 58-62. IEEE, 2013.
11. Reshmalakshmi, C., and M. Sasikumar. "Image contrast enhancement using fuzzy technique." In Circuits, Power and Computing Technologies (ICCPCT), 2013 International Conference on, pp. 861-865. IEEE, 2013.
12. Demirel, Hasan, CagriOzcinar, and Gholamreza Anbarjafari. "Satellite image contrast enhancement using discrete wavelet transform and singular value decomposition." Geoscience and Remote Sensing Letters, IEEE 7.2: pp.333-337, 2010.
13. Maragatham, G., S. MdMansoor Roomi, and T. Manoj Prabu. "Contrast enhancement by object based Histogram Equalization." Information and Communication Technologies (WICT), 2011 World Congress on. IEEE, 2011.
14. Arya P Unni, “Satellite Image Enhancement Using 2D Level DWT”, International Journal of Engineering Research & Technology (IJERT), ISSN:2278-0181,Vol.3 Issue 3, March 2014.
15. Turgay Celik And Huseyin Kusetogullari,” Self-Sampled Image Resolution Enhancement Using Dual-Tree Complex Wavelet Transform” In European Signal Processing Conference, Glasgow, Scotland, 2009.
16. Hasan Demirel And Gholamreza Anbarjafari,”Discrete Wavelet Transform-Based Satellite Image Resolution Enhancement” IEEE Trans. Geoscience And Remote Sensing Letters, Vol.7, No.5, May 2011.
17. Ke, Wei-Ming, Chih-Rung Chen, and Ching-Te Chiu. "BiTA/SWCE: Image enhancement with bilateral tone adjustment and saliency weighted contrast enhancement." Circuits and Systems for Video Technology, IEEE Transactions on 21.3: pp.360-364, 2010.
18. Chauhan, Ritu, and Sarita Singh Bhadoria. "An improved image contrast enhancement based on histogram equalization and brightness preserving weight clustering histogram equalization." Communication Systems and Network Technologies (CSNT), 2011 International Conference on. IEEE, 2011.
19. Ghimire, Deepak, and Joonwhoan Lee. "Nonlineartransfer function-based local approach for color image enhancement." Consumer Electronics, IEEE Transactions on 57.2: pp.858-865, 2011.
20. Josephus, Chelsy Sapna, and S. Remya. "Multilayered Contrast Limited Adaptive Histogram Equalization Using Frost Filter." Recent Advances in Intelligent Computational Systems (RAICS), IEEE, 2011.
21. Hasan Demirel And Gholamreza Anbarjafari, “Satellite Image Resolution Enhancement Using Dual Tree-Complex Wavelet Transform” IEEE Trans. Geoscience And Remote Sensing Letters, Vol.7, No.1, January 2010,Pp123-126.
22. P. Janani, J. Premaladha and K. S. Ravichandran,”Image Enhancement techniques” Indian journal of Technology and Science ISSN (0974-6846), Volume 8(22), September (2015).
23. Tarun Kumar And Karun Verma, “A Theory Based on Conversion of RGB image to Gray image” International Journal of Computer Applications (0975 – 8887) Volume 7– No.2, September 2010.