Analysis of Image Enhancement Process in Digital Image Processing using MATLAB

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Abstract – There are many kind of images required for inspection and information according to the sources now a days. An image enhancement process is transformation of to an input image to make the output image better than the input image and provide the better result and transform an input image for future image enhancement process. There are many images like images of satellite and medical images, even real life photographs. This paper is based on to remove the noise and enhances the contrast and picture standard. The process of image enhancement provides the better picture quality and contrast of images by suppressing the noise. An enhancement technique is application oriented; there is necessary thing for the enhancement process that is to find the simple operations for the image enhanced. The main source for receiving the information from the real world is image. Images are taken or captured in many positions and situations in the real world. Due to this there is need of image preprocessing method at the captured image to remove the noise, making sharp, remove unwanted background according to the application. An image enhancement method is the first preprocessing step in which authors propose the image with more clarity. There are many algorithms proposed for image enhancement for solving the image learning optimization process.

Index Terms – Image enhancement, Error Analysis, metrics, Contrast Enhancement, Image Segmentation, digital image processing (DIP), Spatial domain techniques, Frequency ,domain techniques.

1. INTRODUCTION

The image processing is very famous area for the research work now a time with the continuous development of computer science and technology. Digital Image Processing (DIP) with the continuous development of computer science and technology, the field of Image processing is considered as a very active area of research. Digital Image Processing (DIP) provides the processing of digital images or we can say digital computer provides the digital image with better picture quality. The aim of Digital Image Processing is to produce the better contrast and picture quality. When this process is applied to an input image then the output image will be more suitable and there are many enhancement technique are required for better picture quality. Image Enhancement provides the information about the image and removes the noise from the picture and improves the quality and contrast of image. This process is involved the contrast enhancement, noise reduction, image sharping operation to provide the best quality of image. Contrast enhancement process has the very important role in image processing. Histogram process is involved in gray level scale to provide the best picture quality. The picture is assumed to provide knowledge to the human viewers. Computers are very fast and very accurate than the human in the processing of numerical data. But human has the capability of recognition very fast than the computer because human has the five sensory organs to collect the information from the outside world. Among all these five perceptions, visual perception has the very important role other than all perception as smell, touch, taste and hearing. The old Chinese proverb 'An image told about the thousands words about the anything without written anything. An image enhancement process is applied to an image to provide the better contrast, edges of image, clarity of image than the real image. An image enhancement process is applied in many fields to analysis the behavior of thing as medical image analysis, analysis of satellite image etc. After provide the enhancement process at the original image, image is used as a further analysis of segmentation and recognition in image processing. In the real world images have the low contrast and unsuitable for the human eyes to read for example X-ray images are unsuitable for the human eyes and have the low contrast.

2. LITERATURE REVIEW

A. Image Contrast Enhancement

In order to find the global optimum of non-linear, non-convex and non-differentiable function defined in the continuous parameter space, Storn and Price [3] told about the Differential Evolution algorithm in 1995. DE and its variants emerged as versatile family of the evolutionary computing algorithm and produced the successfully solve numerous real world problems. This proposed method converged faster and with more certainty than Adaptive Simulated Annealing. L.S. Coelho et. al. [12] proposed three differential evolution approaches based on chaotic sequences using logistic equation for contrast enhancement purpose. The main purpose of this technique is to maximize the fitness criterion so as to enhance the contrast and detail in the image by adapting the parameters using contrast enhancement technique. Results are compared with classical DE and showed that the application of chaotic sequences improve the performance of classical DE optimization algorithm. In 2010, Q. Yang et al. [17] told about the adaptive image contrast enhancement algorithm based on differential

evolution to tune gray transform automatically. Tubbs advocated a systematic beta function that has the incompleteness that shows the non linearity it enhance the image contrast. But defining the coefficients of the beta function was a problem. He advocated about the enhancement of contrast in image using the differential evolution algorithm and in the last to find the α , β function. To avoid trapping into local optimum, a chaotic differential evolution algorithm was proposed. Experimental results showed that the proposed algorithm can find the global optimal α, β in little iteration and save computational time and complexity. In 2012, M.C. Lee et al. [21] proposed an automatic image enhancement tool for smart phone by using interactive differential evolution (IDE). From a remarkable progress of the camera sensor in mobile devices, people took pictures with their mobile phone. However, as they were not satisfied with their images, they wanted to edit by using mobile applications, which were complex and cause user fatigue. To reduce it and make a simple interface, author exploited IDE. He proposed color enhancement tool by using IDE. Not only it was simple and convenient, but it also relieved the user fatigue. Five experiments were conducted and twenty people participated in the experiment to evaluate the user satisfaction and fatigue degree. Thirty four images were used for evaluation and comparison. The enhanced images compared with the original and other two images generated by IGA and PE studio. In addition, the best-fit crossover rate was found to reduce the color bias of the images. In 2014, P.P.Sarangi et al. [26] proposed the enhancement of contrast in the image at gray level there is used the transformation function that is assumed as n objectivity of function. The task of D.E was to adapt the parameters of the transformation function by maximizing the objective function criterion. This criterion defined as fitness function of DE. The practical outcome examine with the other enhancement technique as contrast stretching, histogram equalization and particle swarm optimization (PSO) based image enhancement techniques. In all images it is found that DE images contain more detail information than the other methods. Thus the results obtained by DE found better. In 2014, L.M. Rasdi et.al. [27] Proposed an adaptive DE based on chaotic sequences and random adjustment for enhancing the contrast of image. Advocated the process of two variations of adaptive DE for application of optimal image contrast enhancement. The first technique is used in image enhancement DE using chaotic sequences and the second was DE based on random adjustment of the parameters. The objective is to increase the fitness criterion. The results are compared with classical DE which shows that the proposed DE gives best objective function. In 2016, G.E. Guraksin [33] proposed an underwater enhancement approach by using differential evolution algorithm. Here, the underwater image firstly separated into RGB color components in the sense of the objective of improving underwater images. While improving contrast, differential evolution (DE) algorithm used in order to determine the contrast limits. Differential evolution described limits as a fraction between 0.0 and 1.0. After improving contrast, underwater images sharpened by using unsharp masking and the enhanced version of the underwater image was obtained. In all these papers, Differential Evolution algorithm used in order to increase the contrast of the image. While improving contrast, this algorithm also determines the contrast limits.

B. Image Segmentation

S. Rahnamayan et. al. [8] proposed image thresholding based micro Opposition-Based Differential Evolution (micro-ODE). In this approach, micro DE segmented the image into 2 classes by minimizing the dissimilarity between input gray level image and binary image. Then the result was compared with thresholding-method Kittler algorithm which showed that proposed approach is superior to the Kittler algorithm. S. Fan et. al. [19] presented Infrared Electric image segmentation using Fuzzy Renyi Entropy (FRE) and Chaos Differential Evolution algorithm (CDE). In this paper, the histogram of image is transformed into fuzzy domain and the fuzzy entropy of object as well as background is computed by using Fuzzy Renyi Entropy. Then a chaos DE algo was presented to find the optimum threshold. Results showed that presented method is more effective and less time-consuming. A.Nakib et. al. [20] presented an enhanced version of the classical DE algo using low-discrepancy sequences and a local serach, called LDE which is used to compute the parameters of Gaussian distribution. Experimental results showed that LDE produces satisfactory result, thus indicating that it can be used for image segmentation in multi-thresholding due to its computational efficiency. In 2014, S. Paul et. al. [28] proposed a histogram based image compression technique on multi-level image thresholding. Shannon's entropy is maximized to obtain the best threshold. This entropy is maximized using metaheuristic algorithm named Differential Evolution which reduces the computational time and standard deviation of objective value. For comparison and testing, important quality metrics- PSNR, WPSNR and storage size of the compressed image are used. Ouarda et.al. [29] proposed two approaches PSO and DE to find the optimal thresholds of an image, based on the concept of fuzzy C-partition and maximum entropy principle. Two approaches were compared and results showed that both algorithms are comparable in terms of solution quality when threshold number is small. While when this number increases, PSO and DE provide same results in terms of accuracy and robustness, but in terms of execution time PSO is more efficient. Y.J. Gong et.al [30] presented a paper which deal with the superpixel segmentation problem using optimization technique DE. The proposed method produce super pixels in a computation time linear to the size of image. Results showed that the proposed algorithm works well on the Berkeley segmentation benchmark in terms of boundary recall, under segmentation error and time overhead. In 2015, Y. Shi et. al.

[31] proposed an improved DE with mutation strategy and adaptive parameter controlling method (MApcDE). This is proposed to overcome the relation between computation time and dimensions. Results showed that this method can get more efficient results when compared with other threshold methods and the computation time is shortening. These papers proposed DE based image segmentation techniques. Chaos DE algorithm was also used to find the optimum threshold. Results showed that DE reduces the computational time and standard deviation of objective values.

3. RESULT AND SIMULATION

In this project we have analyzed the image enhancement process at the image to improve the quality and contrast of image. We have used the MATLAB software 8.1 versions to analyze the image in different parameters as average of an image, median of image and noisy image.

There are following result are shown in figure.

Fig.1 Original Image

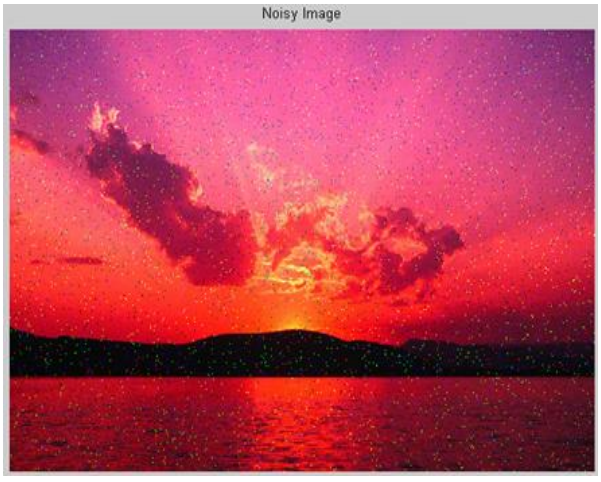

Fig.2 Noisy Image

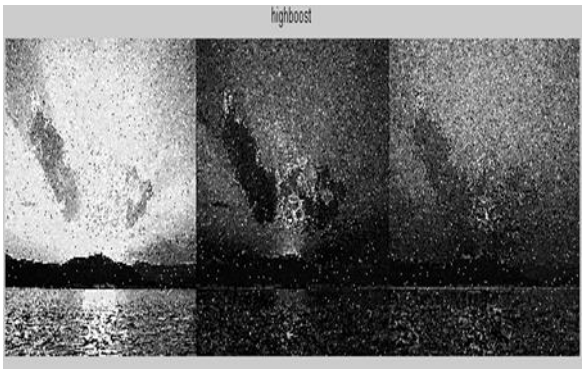

Fig.3 High Boost Image

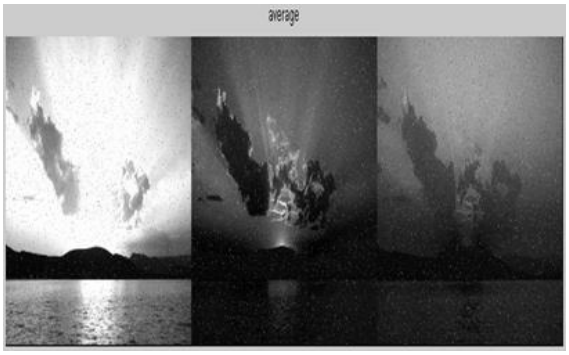

Fig.4 an average of Image

Fig.5 Median of Image

REFERENCES

[1] Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 2002.
[2] S. Jayaraman, S. Esakkirajan, T. Veerakumar, Digital Image Processing.
[3] R Storn, K Price, "Differential Evolution- a simple and effective adaptive scheme for global optimization over continuous spaces," Journal of Global Optimization, vol. 23, no. 1, 1995.
[4] R Storn, K Price, "Differential Evolution- a simple and efficient Heuristic for global optimization over continuous spaces," Journal of Global Optimization, vol. 11, no. 4, pp. 341-359, 1997.
[5] P. Thomas, D. Vernon, "Image Registration by Differential Evolution," in Proceedings of the Irish Machine Vision and Image Processing Conference, 1997.
[6] Junhong Liu, Jouni Lampinen, "A fuzzy adaptive differential evolution algorithm," in Proceedings of IEEE TENCON'02, 2002.

[7] Yong-Jun Wang, Jiang-She Zhang, "Global Optimization by an improved Differential Evolutionary algorithm," Applied Mathematics and Computation, vol. 188, pp. 669-680, 2007.
[8] S. Rahnamayan, H.R. Tizhoosh, "Image thresholding using micro opposition-based Differential Evolution," 2008 IEEE Congress on Evolutionary Computation, pp. 1409-1416, 2008.
[9] V. Aslantas, "Optimal SVD based Robust Watermarking using Differential Evolution," Proceedings of world congress on Engineering, vol. 1, 2008.
[10] R.Thangaraj, M. Pant, A. Abraham, "A simple adaptive Differential Evolution algorithm," World Congress on Nature and Biologically Inspired Computing, pp. 457-462, 2009.
[11] Basturk, E. Gunay, "Efficient edge detection in digital images using a cellular neutral network optimized by differential evolution algorithm," Expert system with Applications, vol. 36, pp. 2645-2650, 2009.
[12] L. S. Coelho, J . G. Sauer, M. Rudek, "Differential Evolution optimization combined with chaotic sequences for image contrast enhancement," Chaos, Solitons and Fractals, vol. 42, pp. 522-529, 2009.
[13] F. Neri, V. Tirronen, "Recent advances in Differential Evolution: a survey and experimental analysis," vol. 33, no. 1-2, pp. 61-106, 2010.
[14] M. Donelli, A. Massa, G. Oliveri, "A Differential Evolution based iterative multi-scaling algorithm for microwave imaging of dieletric structures," 2010.
[15] Jinsung Oh, H. Hwang, "Feature enhancement of medical images using morphology based homomorphic filter and differential evolution algorithm," International Journal of Control, Automation and Systems , vol. 8, no. 4, pp. 857-861, 2010.
[16] V. Aslantas, R. Kurban, "Fusion of multi-focus images using differential evolution algorithm," Expert Systems with Applications, vol. 37, pp. 8861-8870, 2010.
[17] Q. Yang, "An adaptive image contrast enhancement based on differential evolution," 3rd International Congress on Image and Signal processing, vol. 2, pp. 631-634, 2010 IEEE.
[18] Z. S. Mohamad, A. Darvish, S. Rahnamayan, "Eye-Illusion enhancement using Interactive Differential Evolution," IEEE Symposium on Differential Evolution, pp.1-7, 2011 IEEE.
[19] Songhai Fan, Shuhong Yang, "Infrared Electric Image Segmentation using Fuzzy Renyi Entropy and Chaos Differential Evolution algorithm," in International Conference on Future Computer Sciences and Application, pp. 220-223, 2011.
[20] A. Nakib, B. Daachi, P.Siarry, "Hybrid Differential Evolution using Low- Discrepancy Sequences for Image Segmentation," in International Parallel and Distributed Processing Symposium workshop and PhD Forum, pp. 634-640, 2012.
[21] M.C. Lee, S. Cho, "Interactive Differential Evolution for image enhancement application in smart phone," WCCI 2012 IEEE World Congress on Computational Intelligence, pp. 1-6, 2012.
[22] J. Zhong, J. Zhang, "SDE: a stochastic coding differential evolution for global optimization," International Proceedings of GECCO'12, pp. 975-981, 2012.
[23] A. Ghosh, A. Datta, S. Ghosh, "Self-adaptive differential evolution for feature selection in hyperspectral image data," Applied Soft Computing, vol. 13, pp. 1969-1977, 2013.
[24] Ashish Ghosh, Ajoy Mondal, Susmita Ghosh, "Moving object detection using Markov Random Field and Distributed Differential Evolution," Applied Soft Computing , vol. 15, pp. 121-136, 2013.
[25] S. Sarkar, S. Das, "Multilevel Image Thresholding based on 2D Histogram and Maximum Tsallis Entropy- A Differential Evolution Approach," IEEE transactions on Image Processing, vol. 22, no. 12, 2013.
[26] R.G. Gonzalez and R.E. Woods, "Digital Image Processing," 3rd ed. Publishing House of Industry, Beijing, pp. 129, 142, 174-176, 178
[27] Ms. S. Gupta, Mr. S. S. Purkayastha, "Image Enhancement and Analysis of Microscopic Images using Various Image Processing Techniques," International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 3, May-Jun 2012.
[28] K. K Lavania, Shivali, R. Kumar, "Image Enhancement Using Filtering Techniques." International Journal on Computer Science and Engineering (IJCSE), Vol. 4, No. 01, Jan 2012
[29] J. Tang, E. Peli, & S. Acton, "Image Enhancement Using a Contrast Measure in the Compressed Domain," IEEE Signal Processing Letters, Vol. 10, No. 10, Oct. 2003.
[30] R. Krutsch, & D. Tenorio, "Histogram Equalization," Freescale Semiconductor, Document Number AN4318, Application Note. "Image Enhancement Problem,"
[31] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins Digital. Digital image processing using MATLAB: Coordinate Conventions:
[32] Rafael C. Gonzalez, Richard E. Woods. Digital image processing. Second edition upper saddle River, NJ : Prentice Hall; 2002.
[33] G. E. Guraksin, U. Kose, O. Deeperlioglu, "Underwater image enhancement based on contrast adjustment via differential evolution algorithm," 2016 International Symposium on Innovations in Intelligent Systems and Applications, pp. 1-5, 2016.