Image Enhancement by using Biogeography Based Optimization

Nitika Jearth, Raju Sharma

Abstract—**Digital image enhancement techniques provide a multitude of choices for improving the visual quality of image. Appropriate choice of such techniques is greatly influenced by the imaging modality, task at hand and viewing conditions. The review of some significant work in the field of Image Enhancement and some of the popular approaches used to enhance the image are discussed. We will discuss the development of the image enhancement techniques and their application in the field of image processing .The principle objective of image enhancement techniques are to process an image so that the resulted image is more suitable than the original image for specific application. There are several techniques published and discussed by various researchers and each technique has its own advantages, disadvantages and assumptions.**

Index Terms—**. Biogeography based Optimization, Enhancement, Migration, Segmentation .**

I. INTRODUCTION

Image enhancement is a method that refers to highlight some key information in an image and to weaken or remove some secondary information, which aims to improve the quality of identification in the process at same time. The purpose is to make the objective images more suitable for particular application than the original images, and the results of processing the image are more in line with the characteristics of human visual recognition system or the requirements of the computers. Different methods like image negative, contrast stretching, logarithmic transformation, gamma correction, histogram equalization, are used to enhance an image. In our thesis, Biogeographic based optimization method which has an advantage in image enhancement field is adopted. The proposed algorithm is applied for restoration of image to improve the quality of image. For the purpose of enhancement , fitness function is used which decides species are migrating to other region or not in Biogeography Based Optimization algorithm and in resultant we get enhanced image, so that user can better interpret the image. This thesis introduces a new technique for enhancement of image. There are many optimization techniques which have been used in order to extract best solution. Particle Swarm optimization (PSO), Ant Colony Optimization (ACO), Genetic algorithm (GA) are some of the examples of optimization technique. In this paper, we use biogeography based optimization technique to enhance images.

Manuscript received Aug, 2014.

Nitika Jearth, *Electronics and communication engg.,BBSBEC Fatehgarh Sahib,PTU, ., India.*

Raju Sharma, *Electronics and communication engg.,BBSBEC Fatehgarh Sahib,PTU, ., India.*

II. TECHNIQUES USED FOR IMAGE ENHANCEMENT

A. Contrast stretching

Contrast stretching operation is used for the images of low contrast or dark images. Contrast stretching is the process that expands the range of intensity level in an image so that it can span the full range of intensity and displayed properly on display device. Order of intensity is maintained. Dark pixels in original image become darker in processed image and bright pixels in original image become brighter in processed image. Input grayscale image is shown in Fig. 1(a). More detailed are obtained and contrast become higher in processed image as shown in Fig. 1(b).

B. Gamma Correction

The general form of Logarithmic transformation:

$$s=T(r)=cr^{\gamma} \quad (1)$$

where c and ϒ are contants, r is intensity of original image and s is intensity of processed image.If gamma is less than one lower intensity range in input image is converted to intensity range by expanding dynamic range in processed image. As a result the processed image becomes brighter than the original image. However if gamma is greater than one, the higher intensity range of input original image is mapped to lower intensity range in processed image. . As a result the processed image become more darker than the original image. For this type of transformation by taking constant c is equal to one, exponent is conventionally represented by symbol ϒ (gamma), so that is why this type of transformation or correction is called gamma correction. . Input grayscale image is shown in Fig. 1(a) . More detailed are obtained in processed image by taking gamma equal to 0.9 as shown in Fig. 1(c).

C. Histogram equalization

Histogram of an image is the representation of no. of pixels on Y-axis with respective gray color intensities on X-axis.As mentioned above, for gray levels that take on discrete values, we deal with probabilities:

$$p(r_k)=n_k/n \quad (2)$$

for k=0,1,2,3,……..L-1

r_k is the kth gray level

ISSN: 2278 – 1323

n_k is the # pixels in the image with that gray level
n is the total number of pixels in the image
k = 0, 1, 2, …, L-1
$p(r_k)$is the probability of occurrence of the intensity level r_k in an image. The sum of all components = 1.

The plot of pr(rk) versus rk is called a histogram and the technique used for obtaining a uniform histogram is known as histogram equalization (or histogram linearization). A perfect image is one which has equal no. of pixels in all its gray levels. Hence to get a perfect image our objective is not only to spread the dynamic range but also to have equal pixels in all the gray levels. This technique is known as Histogram Equalization. Histogram equalization is a common used technique for enhancing the appearance of an image. Suppose an image which is predominantly dark. Then its histogram would be skewed towards the lower end of the grey scale and all the image detail is compressed into the dark end of the histogram. If we could `stretch out the grey level at the dark end to produce a more uniformly distributed histogram then the image would become much clearer. . Input grayscale image is shown in Fig. 1(a) . More detailed are obtained in processed image by histogram equalized image as shown in Fig. 1(d).

III. Proposed Algorithm

Island is considered to be the solution of particular problem. The good solution is considered to have high HSI value and poor solution have low value. Let the size of habitat be N.

$$H=[SIV_1, SIV_2, SIV_3, \ldots\ldots SIV_M] \quad (3)$$

Where M is the number of feature to involve for optimal solution.

Segmentation is the process of dividing the image into set of pixels having homogeneous region. It is used to locate boundaries or objects. Close part of image is considered as object[2]. In Migration, pixels having similar intensity, color or characteristics are grouped together when biogeography based optimization applied to image .In BBO each solution learn from their neighboring pixel. Solution changes through migration from other solution. HSI contain pixels that have similar properties and LSI contain the pixel having different properties. Select the threshold value and perform thresholding[2]. The simplest is based on a clip-level or a threshold value to turn a gray-scale image into a binary image. That binary image contains all the information about shape of object of interest. By using thresholding, pixels having similar properties or belongs to HSI are grouped together and pixels having different properties or LSI pixels belongs some other region. As we started we select a seed using some set of predefined criteria. According to the BBO approach make two islands HSI and LSI.HSI (highly suitability index) that contain pixels which have more similar properties. Low suitability index (LSI) that contain pixels which contain pixels that not so familiar. HSI tend to have a large number of species, while those LSI have a small number of species. Then we select threshold[8][9]. If our calculated distance less than threshold then its migrate to other region, otherwise its make its own region.

A. Migration

Image population is considered to be total number of pixels. Population consists of population member or represented by number of pixels or species. Here island is considered as solution of problem or represented by group of similar pixels. Initialize the randomly generated SIV which characterize the population or species[8]. These SIV's represent solution of problem, group of similar pixels, Habitat H or Island. Each SIV is compared with fitness value (HSI). Replace the SIV on the basis of fitness value. After the predefined number of iterations, sort the SIV from best to worse.

B. Mutation

Mutation is process of modifying the value of randomly selected SIV for better solution[8]. Mutation rate explore new SIV values and give better results.

IV. Implementation Results

Steps to be followed

1) Take input image of 256*256 size.
2) Convert it into grayscale image.
3) Initialize BBO parameters such as total number of pixels and total number of iterations
4) Evaluate suitability index of each island. Population is represented by total number of pixels in image. Features can be represented by HSI and LSI.
5) Evaluate the fitness of each habitat which is known as HSI in BBO .If the fitness of previous pixel value is greater than current pixel value after considering fitness evaluation which depends upon global intensity value of image, it should be replaced.
6) Extract the best solution and we get segmented image.
7) Adjust the contrast of image and converts the elements of an array into unsigned 8-bit (1-byte) integers of class uint8 grayscale image. Enhanced output image give more detail and higher quality.
8) Check for termination criteria .If maximum generation is reached, stop execution otherwise go to step 4.

Input image is shown in Fig. 2(a).Convert it into grayscale image as shown in Fig. 2(b).Segment the grayscale image by using Biogeography based optimization(BBO) and segmented image is shown in Fig. 2(c).Enhance the features of image by using Biogeography based optimization. More detailed are obtained and contrast become higher in processed image by Biogeography based optimization image as shown in Fig. 2(d).The output image become clearer and quality of image is improved by using proposed algorithm.

Fig. 1(a): Grayscale image

Fig. 1(b): Enhanced Image by Contrast stretching

Fig. 1(c): Enhanced Image by Gamma correction

Fig. 1(d): Enhanced Image by Histogram Equalization

ISSN: 2278 – 1323

Fig. 2(a): RGB Iimage

Fig. 2(b): Grayscale image

Fig. 2(c): Segmented Image by using BBO

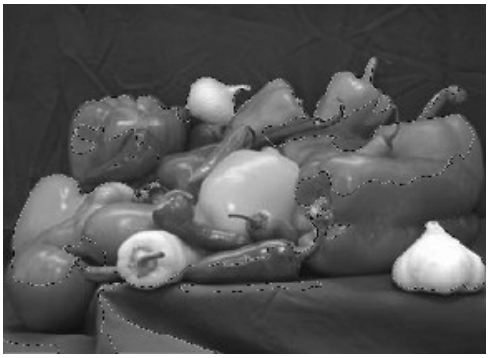

Fig. 2(d): Enhanced Image by using BBO

V. CONCLUSION

Image enhancement processes consist of a collection of techniques. That seek to improve the visual appearance of an image or to convert the images to a form better suited for analysis by a human or machine. The presented contrast enhancement techniques are effective in enhancing natural images. From these three techniques, Histogram Equalization gives best result and hopefully could give extra information. As a result, natural images that have been applied with this technique appear to be clearer and hopefully would ease further analysis by viewers. Gamma correction, Contrast stretching and Histogram Equalization techniques that commonly used for natural images. Contrast stretching, Gamma correction and Histogram Equalization play an important role in enhancing the quality and contrast of natural images. Various optimization techniques are Particle swarm optimization, Genetic algorithm and biogeography based optimization. From these three techniques, Biogeography based optimization technique gives best result. It is clear BBO is more reliable and better optimizer as compared to other optimization techniques. So In thesis BBO technique is applied for the restoration of image. Biogeography based optimization technique play an important role in enhancing the quality and contrast of natural images.

ACKNOWLEDGMENT

I express my sincere gratitude to the Punjab Technical University, Jalandhar for giving me the opportunity to work on the thesis during my final year of M.Tech. Thesis work is an important aspect in the field of engineering. I would like to place on record my deep sense of gratitude to Dr. Lakhwinder Singh Principal BBSBEC Fatehgarh Sahib for his stimulating guidance and continuous encouragement. I would also like to thank Dr. Hardeep Singh Ryait, HOD, Electronics & Comm. Dept., BBSBEC, Fatehgarh Sahib for his valuable inputs and help.I would also like to thank Mr.Tripatjot Singh M.Tech Coordinator, Electronics & Comm. Dept., BBSBEC, Fatehgarh Sahib for his valuable inputs and help.I owe my sincerest gratitude towards Ms. Raju Sharma for her valuable advice and healthy criticism throughout my thesis which helped me immensely to complete my work successfully.

REFERENCES

[1] Ammu,P.K.,Sivakumar,K.C.,Rejimoan,R.,2013"Study Biogeography-Based Optimization - A Survey" International Journal of Electronics and Computer Science Engineering, Volume 2, Issue 1, ISSN: 2277-1956, pp 154-160.

[2] [2] Al-amri,S.S., Kalyankar, N.V., Khamitkar,S.D,"Image Segmentation by Using Threshold Techniques" Journal of Computing,volume 2,issue 5, May 2010, available online at https://sites.google.com/site/journal of computing/www.journal of computing.org.

[3] Gonzalez, R.C. and Woods, R.E.,2002 "Chapter 10: Image Segmentation," in Digital Image Processing, 2nd edition Upper Saddle wood river N.J Prentice Hall, pp. 567-642.

[4] Goyal,A., Bijalwan,A., Chowdhury,K., June 2012 "A Comprehensive Review of Image Smoothing Techniques " International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 4,ISSN: 2278 – 1323,pp 315-319.

[5] Gupta,S., Bhuchar,K., Sandhu,P.S., 2011 "Implementing Color Image Segmentation Using Biogeography Based optimization" International Conference on Software and Computer Applications , vol.9, pp 79-86.

[6] Gupta.S, Sandhu,G.S., Mohan.N.,2012 "Implementating Color Image Segmentation using Biogeography Based Optimization"International Conference on Computer and Communication Technologies May 26-27, 2012, pp 167-170 .

[7] Kaur,G.,Kaur.H., April 2013 "A Review on Medical Image Segmentation Using Biogeography Based Optimization," International Journal of Emerging Research in Management &Technology ,Volume-2, Issue-4 ,ISSN: 2278-9359, pp 35-38.

[8] Kaur,G.,Kaur.H., February 2013 "A Survey on Comparison between Biogeography Based Optimization and Other Optimization Method," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 2, ISSN: 2277 128X ,pp 438-440.

[9] R. C. Gonzalez and P. Wintz., 1987."Digital Image Processing," 2nd Edition, Addison-Wesley Publishing Co., Reading, Massachusetts.

[10] Senthilkumaran.N. and Rajesh.R., May 2009 "Edge Detection Techniques for Image Segmentation – A Survey of Soft Computing Approaches " International Journal of Recent Trends in Engineering, Vol. 1, No. 2,pp 250-254.

[11] Simon,D.,December 2008 "Biogeography-Based Optimization"IEEE Transactions on Evolutionary Computation, Volume 12, Issue 6, pp 702-713.

[12] Singh, A. and Kaur, M., August 2013, "Enhancement and De-Noising Techniques for Gray Scale Images using Spatial Domain Filtering " International Journal of Science and Research, Volume 2 Issue 8, ISSN: 2319-7064 ,pp 318-321.

Nitika Jearth Research Scholar,from Nangal pursuing M.Tech. in Baba Banda Singh Bahadur College, Fatehgarh Sahib in Electronics and communication Engineering .She graduated from Rayat Institute of Engineering and information Technology, Railmajra in Electronics and communication trade in 2008.She has presented four journals in international conferences and five paper in national conference. She has published international journal on Implementation of Biogeography based optimization on image restoration in 2012 and restoration of blurred image using Biogeography based Optimization, Image restoration using Biogeography based segmentation, Restoration of Gaussian blur by Biogeography Based Optimization in 2013. Research interest are in Matlab based Image Steganography, Restoration and Enhancement techniques, Biogeography based optimization technique.

Raju Sharma Assistant professor, from Nangal, She has completed M.Tech. from Baba Banda Singh Bahadur College ,Fatehgarh Sahib in Electronics and communication Engineering in 2011. She graduated from same college in Electronics and communication trade in 2005.She has presented six jounrals in international conferences and two paper in national conference. She has published international journal on Implementation of Biogeography based optimization on image restoration,Image Segmentation using RGB decomposition and modified Bacterial Foraging optimization in 2012 and restoration of blurred image using Biogeography based Optimization, Image restoration using Biogeography based segmentation, Restoration of Gaussian blur by Biogeography Based Optimization in 2013 in field of image processing. Research interest are in Matlab based projects and wireless communication. She has guided many projects at graduate and master level.

