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Contrast Enhancement Based on BAT Algorithm

Pooja, Jyoti Rani

GZS PTU Campus, Bathinda, gargaarzoo5@gmail.com, 9478002224

Abstract— In this research paper, an algorithm is developed to produce better contrast enhancement which is inspired from nature and calculates the upper and lower limit for each sliding window. These upper and lower limits are used to calculate the local mean and global mean. It is based on contrast objective function; this is parabolic logarithmic threshold function. The results show that, the method is able to produce better contrast sensitivity and pleasing visuals as compared to older methods(histogram equalization, adaptive histogram equalization, fusion of pyramid and Gaussian , ant colony optimization method etc). The corpus of image consists of both gray and color images. Other than these other evaluation values like loudness, pulse rate, frequency show that this method provides better contrast ratio.

Keywords- Bat algorithm, Contrast Enhancement, Fusion Method

INTRODUCTION

Contrast enhancement is a commonly used operation in Image Processing. Contrast, is a property of image which makes the visual appearance better by adding color grading in the image. Contrast is calculated in terms of color and brightness of the object and other objects within same view of field. Contrast enhancement is the operation which is used in Medical images. It plays an important role for processing scientific images such as X-rays or satellite images. There are many methods proposed to enhance the contrast of an image. The most simplest and effective method for contrast enhancement is Histogram Equalization. The basic idea behind Histogram Equalization was to rescale the gray levels of image. Histogram Equalization removed the annoying artifacts and unwanted noise. The limitation of histogram equalization was that it applied on entire image whereas this limitation was overcome by Adaptive histogram Equalization which operated on small regions/blocks.

The improved version of Adaptive histogram Equalization was Contrast Limited Adaptive Histogram Equalization which partitioned images into contextual regions and then histogram equalization was applied. This process evens out the distribution of gray pixel values and make out the hidden details visible to human. To improve contrast there was a Dualistic Sub Image Histogram Equalization in which the original image was decomposed into two equal sub images based on its gray level probability density function. On the basis of normalized law function they changed the sub histogram through weighting process and then equalized the weighted sub Histogram Enhancement of contrast using Weighted Threshold Histogram Equalization with Improved Switching Median Filter. The general idea adopted by WTHE was to modify the histogram and assigned weight and threshold to each pixel before equalization. Filtering played a vital role in signal processing and main goal of filtering was to enhance fine details of an image. The image was enhanced by WTHE then it passed through Improved Switching Filter, in improved switching median filtering it modified the corrupted signal without affecting uncorrupted signal and reduced the impulse noise created during enhancement. The performance of this method was evaluated by Absolute Mean Brightness Error (AMBE), Measure of Enhancement (EME), PSNR, and MSE. There were few bio inspired algorithms applied for contrast enhancement such as Ant Colony Optimization, Improving Ant Colony Optimization, Local and Global Contrast Algorithm, Firefly Algorithm.

PROPOSED WORK

Bat Algorithm

1. Objective function f(x), x = (x1; :::; xd)^T

2. Initialize the bat population x_i for i:::::::::n

v_i= pulse distance/ time

f_i = fmin + [fmax-fmin] *** β**

where **β** is frequency adjustment constant.

3. Let Amin to Amax be the loudness range dependent upon frequency and emission rate as the emission rate slows when the loudness increases and vice versa.

4. Let λ be the wavelength at a fixed value

For each iteration,

x_o be the starting search point.

Get Position x, Loudness A, frequency f, Wavelength λ

Generate Random solution.

If new solution is better than old solution

Terminate

Else

5. Update position, loudness, frequency, emission rate.

Generate Random number between 0 and 1.

If (rand> pe)

Select best solution

Generate local solution among best solution

If(rand< Ai) and $f(x_1) < f(x_2)$)

Accept solution

Increases pe(pulse emission rate) and reduce A(loudness)

End

Table I

Showing BAT Parameters and its values

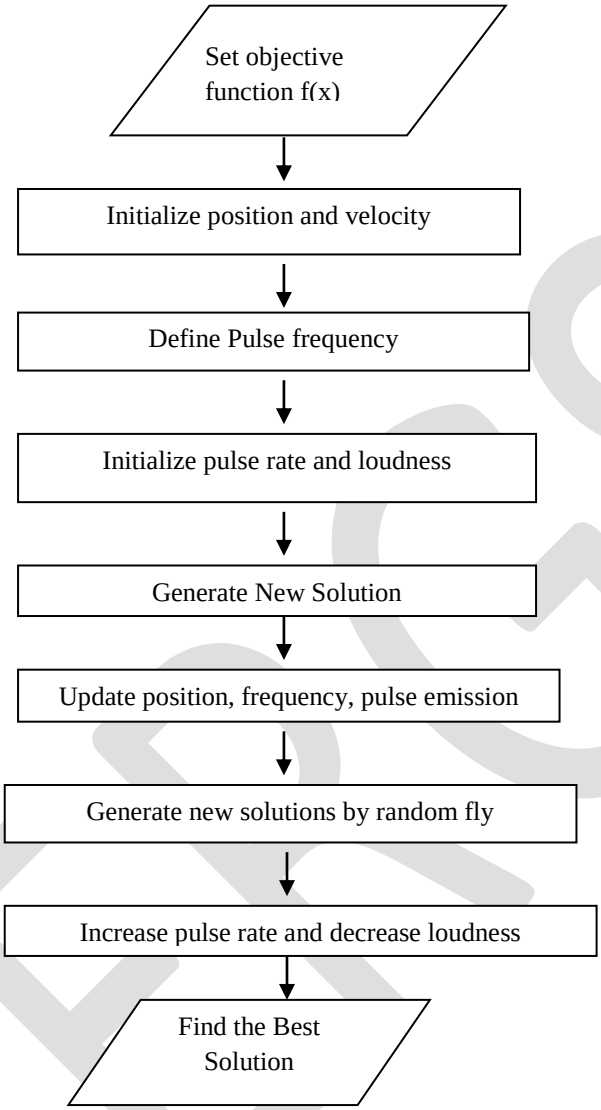
Sno	BAT Parameters	Values
1	Population Size (Bat Number)	20
2	Loudness	0.5
3	Minimum Frequency	0.1
4	Maximum Frequency	2
5	Pulse Rate	0.4
6	Number of Generation(Iterations)	1000
7	f(x), x = (x1; :::; xd) Objective Function	[0,1]
8	Upper Bound	4
9	Lower Bound	1
10	Design of Experiment for Optimal parameters method	5

Table II

Showing Research Parameters and its values

Sno	Research Parameters	Values
1	Number Of Images	15
2	Size of Images	8KB-1.12MB
3	Contrast Upper value	1
4	Contrast Lower value	0.1

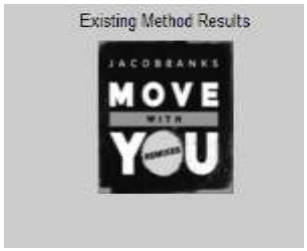
FLOW CHART



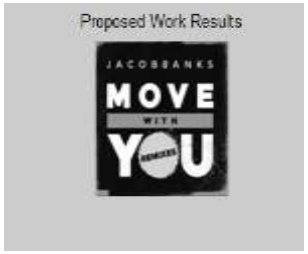
RESULTS

In the previous work researchers enhanced the contrast of an image but with some limitations such as unwanted noise, artifacts, more computation time. In the current research work it is wise to enhance the contrast of an image by using nature inspired algorithms which gives the better results

(a)



(b)

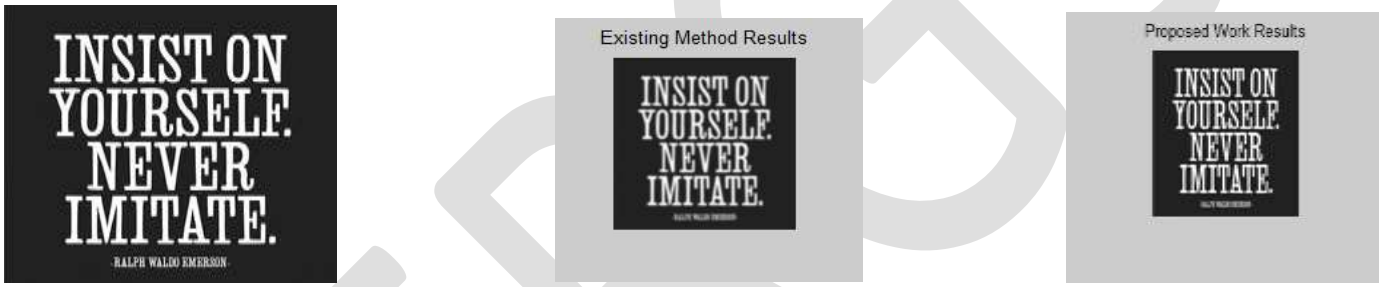


(c)

Fig1 : (a) Original Image (b) Apply fusion method of Pyramid and Gaussian (c) Proposed Method

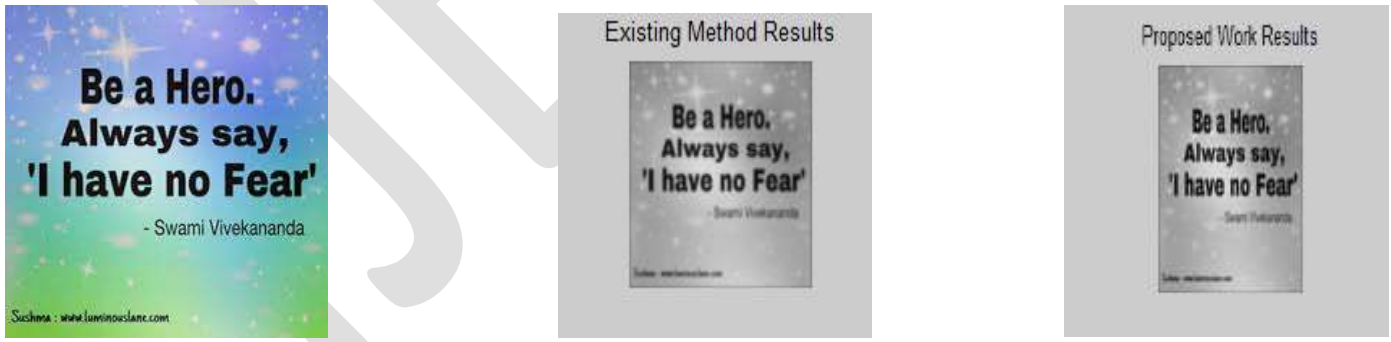
(a) (b) (c)

Fig2 : (a) Original Image (b) Apply fusion method of Pyramid and Gaussian (c) Proposed Method



(a) (b) (c)

Fig3 : (a) Original Image (b) Apply fusion method of Pyramid and Gaussian (c) Proposed Method



(a) (b) (c)

Fig4 : (a) Original Image (b) Apply fusion method of Pyramid and Gaussian (c) Proposed Method

Table III

Comparison with Existing Method

Images	Fusion of Gaussian and Pyramid	Proposed Method
Fig 1	84.5738	87.7512
Fig 2	97.8488	99.2395
Fig 3	66.050	73.6042
Fig 4	39.7182	43.1568

This table shows that the proposed method which is bat based contrast enhancements gives better results as compared to existing method which was based on fused based.

CONCLUSION

In summary, we can say that contrast enhancement methods must be able to produce images that are not just pleasing to human eyes and perception, but also must be able to produce more information within the content of image. There are many methods implemented till date, and most of the methods were based upon stretching the edges of objects. In such a way, difference in gray levels or color levels increases and the image does not lose its quality, or may introduce unwanted artifacts when image is reproduced after contrast enhancement algorithm applications. In this research work, we were able to do a better treatment in context of contrast, as it is apparent from the evaluation parameters. The results produced by proposed method shows better results as compared to the existing fusion based method. The existing method gives values in terms of grey level variance 40.5807, 63.9614, 66.050 of some images whereas proposed method gives 44.5555, 65.0935, 73.6042 and this shows the better contrast enhancement.

FUTURE SCOPE

In future, we suggest the proposed method may be extended for medical images that follow some standards like Health Level 7 (HL7), as these images need multi-resolution, multi-contrast view to satisfy at particular diagnostic process.

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