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LL Band Contrast Enhancement Using Adaptive Gamma Correction

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Abstract

Visible first-class of a photograph can be stepped forward by picture comparison enhancement. Enhancement is used to attain the hidden info present in a picture. It increases the comparison of part of a photograph which having the more data about the photograph. Picture enhancement may be obtained in many ways; histogram equalization is one of the most important and broadly used techniques of image enhancement. It complements the picture by using remapping the original pixel in to the uniform level. It complements a photograph in a great manner however it produces the noise amplification effect and over and below enhancement effect. The drawbacks can be removed via a brand new technique LL Band evaluation enhancement the use of adaptive gamma correction. The enhancement is obtained with the aid of Adaptive Gamma Correction of LL Band. The proposed method gives the higher enhancement it additionally preserves the brightness of the image. The proposed method is analysed for low evaluation take a look at pictures. It really works nicely by using imparting enhancement and advanced brightness. Experimental consequences suggest that the enhancement is acquired with stepped forward brightness as compared to the prevailing techniques .

Keywords: Aptive Gamma Correction Ll Band, Image Enhancement, Histogram Equalisation

1. Introduction

Comparison enhancement is broadly obtained by using the histogram change techniques. One of the easy strategies is histogram equalisation[4] its miles broadly used due to its powerful enhancement and less complexity. Histogram equalisation can be calculated by the assessment of CDF values. However it produces over enhancement because of the flattering of authentic image histogram but it may not produce the uniform histogram due to the discrete nature of the pixel values. Brightness retaining Bi-Histogram Equalization (BBHE)[1], divides the input histogram into subsections primarily based on the mean cost. Dualistic Sub-Photograph Histogram Equalization (DSIHE), which has been proposed by way of Y. Wang, Q. Chen and B. Zhang[2], also separates the enter histogram into subsections, however the separation is based on the median value. Chen and Ramli additionally have proposed some other method called Recursive Mean-Separate Histogram Equalization (RMSHE)[3]. RMSHE recursively divides the histogram into several subsections based totally on the local suggest values. The variety of sub-sections is about by using the user Recursively Separated and Weighted Histogram Equalization (RSWHE). The fundamental idea of RSWHE is to phase an enter histogram into or extra sub-histograms recursively, to alter the sub-histograms by means of a weighting procedure primarily based on a normalized strength law function, and to perform histogram equalization on the weighted sub-histograms independently. RSWHE consists of 3 modules: (Histogram Segmentation Module) cut up an input histogram into two or extra sub-histograms recursively primarily based at the mean or median of the picture; (Histogram Weighting Module) change the sub histograms via a weighting method primarily based on a normalized electricity law function; (Histogram Equalization Module) ultimately, equalize the weighted sub-histograms independently.

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2. Previous Work

This section describes previous algorithms and methods for contrast enhancement in the literature.

2.1 Histogram Equalisation (HE)

Histogram Equalization (HE) is a conventional technique for contrast enhancement. The enhancement is obtained by way of the calculation of PDF and CDF then based totally at the CDF the very last image is acquired with the assist op remapping the unique photo pixel the enhancement is received histogram equalization is received by the following steps.

Step 1: Probability Density Function: X ={X(x,y)} is a two-dimensional image composed of L discrete gray levels. The probability density function (PDF) is defined by,

$$PDF(l) = \frac{n_l}{MN} \quad (1)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ...,+l_{max}$, n_l denotes the number of pixels for luminance l, and MN denotes the total number of gray level pixels in the input image.

Step 2: Cumulative Density Function: From the PDF values the cumulative density function is calculated by,

$$c(l) = \sum_{l=lmin}^{lmax} PDF(l) \quad (2)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ...,+l_{max}$, PDF(l) denotes probability density function for luminance l.

Step 3: Transform Function: Transform function f(l) based on cumulative density function is defined by,

$$f(l) = lmin + (lmax - lmin)c(l) \quad (3)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ...,+l_{max}$, $c(l)$ denotes cumulative density function for luminance l.

Step 4: Histogram Equalisation: The output image of the histogram equalization can be expressed as,

$$y = f(l) \quad (4)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ...,+l_{max}$, $f(l)$ denotes transform function for luminance l.

2.2 Brightness Preserving Bi-Histogram Equalization (BBHE)

BBHE sub divide the unique picture histogram in to 2 exclusive histograms by means of the reference of the imply cost of an original image. Then the sub divided photo histograms below is going histogram equalization one by one. The subsequent steps to be accomplished to gain Brightness Maintaining Bi-Histogram Equalization (BBHE).

Step 1: Mean Computation: The mean of the image x_m for the low contrast input image is computed.

Step 2: Bi-Histogram Formation: From the mean value the input image is decomposed in to two sub images x_L and x_U is represented by,

$x_L = \{x(i,j) | x(i,j) \le x_l m\}$

$x_U = \{x(i,j) | x(i,j) > x_m\}$

Where x is input image and $x = x_L \cup x_U$. x_L and x_U x_U are the sub images.

Step 3: Histogram Equalisation of Sub Images: Histogram equalisation of sub images is performed as same as the Traditional histogram equalisation.

2.3 Dualistic Sub-Image Histogram Equalization

The same steps are followed to obtain the DSIHE instead of mean value the median value is used to subdivide the input image histogram.

2.4 Gamma Correction (GC)

A Gamma Correction technique changes the pixel values of an image by varying the exponential value (i.e) gamma. The Gamma Correction is represented as follows,

$$T(l) = l_{max} \times \left(\frac{l}{l_{max}}\right)^{\gamma} \quad (5)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ...,+l_{max}$, T(l) denotes the transformed luminance l.

The contrast of an image is improving in a better way but the enhancement is not depends on the input pixel values it enhances the image in a similar way.

2.5 Adaptive Gamma Correction (AGC)

In AGC algorithm the gamma value is calculated with respect to PDF and CDF values.The following are the different steps involved in Adaptive Gamma Correction algorithm.

Step 1: Probability Density Function: X ={X(x,y)} is a two-dimensional image composed of L discrete gray levels. The probability density function (PDF) is defined by,

$$PDF(l) = \frac{n_l}{MN} \quad (6)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ..., +l_{max}$, n_l denotes the number of pixels for luminance l, and MN denotes the total number of gray level pixels in the input image.

Step 2: The Weighting Distribution Function: The weighting distribution function can be expressed by,

$$PDF_w(l) = \max(PDF) \times \left(\frac{PDF(l) - \min(PDF)}{\max(PDF) - \min(PDF)}\right)^{\alpha} \quad (7)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ..., l_{max}$, $PDF_w(l)$ represents the weighting probability density function, max(PDF) denotes the maximum probability density of PDF(l), min(PDF) denotes the minimum probability density of PDF(l), and α represents the adaptive parameter that can be set to 0.5.

Step 3: Smoothed Cumulative Distribution Function: The original cumulative distribution function (CDF) is smoothed and can be expressed by using the $PDF_w(l)$ by,

$$CDF_s(l) = \sum_{l=lmin}^{lmax} \frac{PDF_w(l)}{\sum PDF_w} \quad (8)$$

For $l = l_{min}, l_{min}+1, l_{min}+2, ..., l_{max}$, $\sum PDF_w$ represents the sum of the weighting probabilities, and CDF_s represents the smoothed CDF.

Step 4: Adaptive Gamma Correction: By using the Gamma Correction, the transform function can be calculated by,

$$T(l) = (l_{max} - l_{min}) \times \left(\frac{l}{l_{max} - l_{min}}\right)^{\gamma} \quad (9)$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, ..., l_{max}$, with T(l) representing the transform function $\gamma = 1 - CDF_s(l) \times P$ with P represents the adaptive parameter that can be set to 1.

Step 5: Final Luminance Transformation: The output image of the proposed algorithm

Y ={Y (i, j)} can be expressed by,

$$Y=\{T((X(i,j))| \forall \; X(i,j) \in X\} \quad (10)$$

Where X (i, j) represents the intensity of the incoming image at the location (i, j) and Y (i, j) represents the intensity of the output image at the location (i, j).

3. Proposed Algorithm

The proposed algorithm is performs the AGC algorithm for LL Band of an input image. The contrast of an image is enhanced smoothly by enhancing the luminance values present in the LL Band.

Step 1: Image Acquisition

Step 2: LL Band Extraction: LL Band of an image is separated from the original image by taking DWT of an original image by make the original image in to fist order decomposed image and separate the LL Band from the original image

IDWT can provide the exact inverse operation so the loss of information is not present in wavelet based decomposition technique.

Step 3: Obtain Adaptive Gamma Correction of LL Band image,

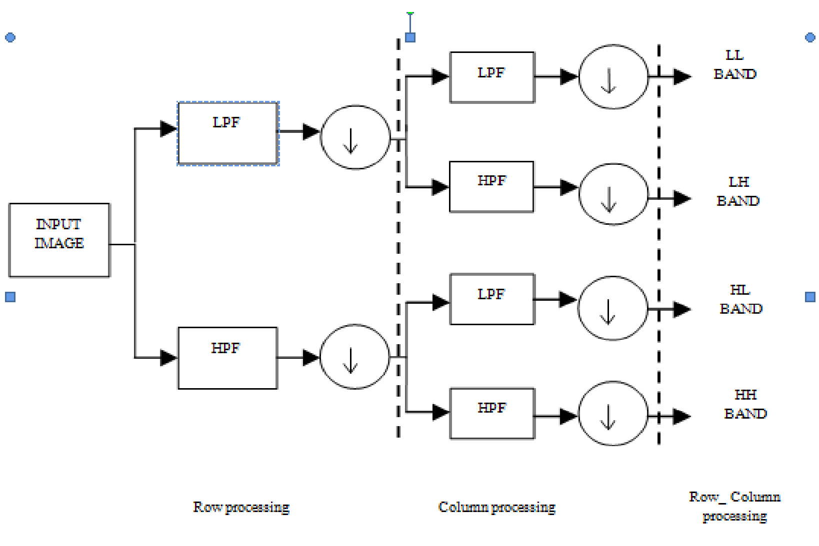


Figure 1. Block Diagram of DWT.

The LL Band image undergoes AGC by the AGC algorithm

$$T(l) = (l_{max} - l_{min}) \times \left(\frac{l}{l_{max} - l_{min}}\right)^{\gamma}$$

Where $l = l_{min}, l_{min}+1, l_{min}+2, \ldots, l_{max}$, with $T(l)$ representing the transform function $\gamma = 1 - CDF_s(l) \times P$ with P represents the adaptive parameter that can be set to 1.

Step 4: Obtain Final Image: By combining the LL Band image with remaining bands to obtain the reconstructed image (i.e) contrast enhanced image.

4. Results and Discussion

The proposed LL Band enhancement algorithm is analysed and implemented using MATLAB2013a. AMBE parameter and PSNR values are calculated for the performance analysis of the proposed algorithm. AMBE is obtained by the mean difference between the output image and an input image PSNR is obtained by,

$$PSNR = \frac{10 \log_{10} r^2}{MSE}$$

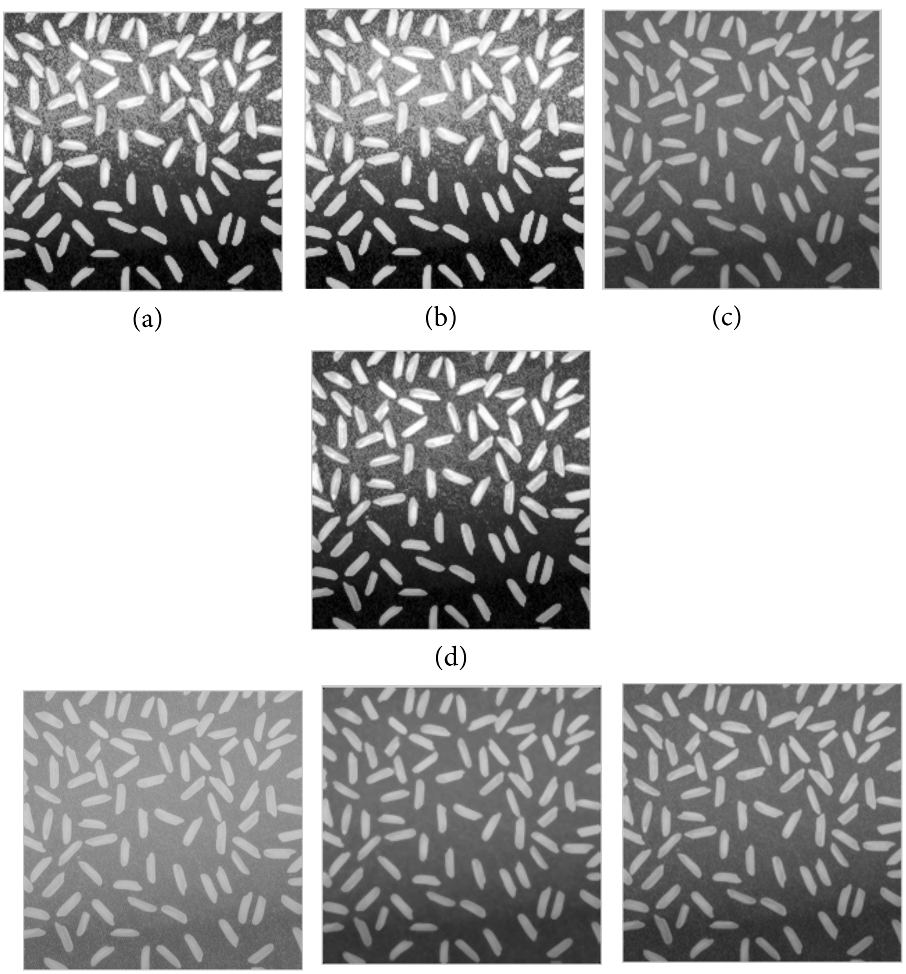
MSE is obtained by,

$$MSE = \frac{\sum(\text{original image} - \text{reconstructed image})^2}{M * N}$$

M = Number of rows in the image matrix.

N = Number of columns in the image matrix.

The proposed set of rules is compared with Histogram Equalisation (HE), Gamma Correction (GC) brightness preserving algorithms such as Brightness Retaining Bi-Histogram Equalisation (BBHE), Dualistic Sub-Picture Histogram Equalisation (DSIHE) and Adaptive Gamma Correction (AGC) and all the combinations of the fusion



(a) (b) (c) (d) (e) (f) (g)

Figure 2. Simulation Results of HE.

with the pictures acquired by means of present algorithms when as compared with brightness retaining set of rules proposed algorithm is having minimal AMBE fee and the output photo having advanced visual great than the AGC algorithm.

GC,BBHE,DSIHE,AGC and LL band AGC algorithms **(a)** Original image **(b)** Histogram Equalised image **(c)** Brightness Preserving Bi-Histogram Equalised image **(d)** Dualistic Sub-Image Histogram Equalisation **(e)** Gamma Corrected Image **(f)** AGC image **(g)** LL Band enhanced image.

Table 1. Absolute Mean Brightness Error (AMBE) For HE,BBHE,DSIHE, GC,AGC and LL Band AGC Algorithms

Enhancement Methods	PSNR(db)
HistogramEqualisation	16.19
Brightness Preserving Bi-Histogram Equalisation	17.28
Dualistic Sub-Image Histogram Equalisation	18.24
Gamma Correction	16.17
AGC	38.92
LL Band AGC	42.9

Table 2. Peak Signal to Noise Ratio (PSNR) For HE,BBHE,DSIHE, GC,AGC and LL Band AGC algorithmsz.

Enhancement Methods	AMBE
HistogramEqualisation	16.17
Brightness Preserving Bi-Histogram Equalisation	9.98
Dualistic Sub-Image Histogram Equalisation	5.74
Gamma Correction	7.08
AGC	1.42
LL Band AGC	0.39

5. Conclusion

In this task, adaptive gamma correction is proposed for LL Band of low contrast pictures. The Adaptive Gamma Correction (AGC) approach is used to acquire the comparison enhancement of low comparison photographs. The comparison enhancement is acquired by using the variation of the gamma values the gamma price is adapted robotically with respect to the in pixel values and the PDF, CDF values of an image. The proposed set of rules can affords better enhancement compared to the prevailing algorithms additionally offers better PSNR and AMBE values while as compared with the existing techniques. The future painting is to apply the AGC algorithm to the video processing programs.

6. References

1. Chen SD and Ramli A. Minimum Mean Brightness Error Bi-Histogram Equalization In Contrast Enhancement. IEEE Transactions on Consumer Electronics. 2003; 49(4):1310-19.
2. Chen SD and Ramli AR. Contrast Enhancement using Recursive Mean-Separate Histogram Equalization for Scalable Brightness Preservation, IEEE Transactions on Consumer Electronics. 2003; 49(4):1301-09.
3. Gonzalez R and Woods R. Prentice Hall: Digital Image Processing, 2nd edition. 1997.
4. Gonzalez R and Woods R. Prentice Hall: Digital Image Processing, 2nd edition. 2002.
5. Huang SC Cheng FC and Chiu YS. Efficient Contrast Enhancement Using Adaptive Gamma Correction with Weighting Distribution, IEEE Transactions. Image Processing. 2013; 22(3):1032-41.
6. Kim Y. Contrast enhancement using brightness preserving bi-histogram equalization. IEEE Transactions on Consumer Electronics. 1997; 43(1):1-8.
7. Kim M and Chung MG. Recursively Separated and Weighted Histogram Equalization For Brightness Preservation And Contrast Enhancement, IEEE Transactions on Consumer Electronics. 2008; 54:1389-97.
8. Menotti D and Najman L. Multi–Histogram Equalization Methods for Contrast Enhancement and Brightness Preserving. IEEE Transactions on Consumer Electronics. 2007; 53(3).
9. Ooi CH and Mat Isa NA. Adaptive Contrast Enhancement Methods with Brightness Preserving, IEEE Transactions on Consumer Electronics. 2010; 56(4):2543-51.
10. Sengee N, Sengee A and Choi HK. Image Contrast Enhancement using Bi-Histogram Equalization with Neighborhood Metrics, IEEE Transactions on Consumer Electronics. 2010; 56(4):2727-34.
11. Sim KS, Tso CP and Tan Y. Recursive sub-image histogram equalization applied to gray-scale images, Pattern Recognition. Letter. 2007; 28:1209-21.
12. Tarik Arici and Salih Dikbas. A Histogram Modification Framework and Its Application for Image Contrast Enhancement. IEEE Transactions on Image Processing. 2009; 18(9):1921-35.
13. Wan Y, Chen Q and Zhang B. Image Enhancement based on equal area Dualistic Sub-Image Histogram Equalization Method. IEEE Transactions on Consumer Electronics. 1999; 45(1):68-75.