ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 8, August 2017

A Exposure Based Technique With Dwt To Enhance The Image

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Abstract— **This paper gives a technique to enhance the contrast of low exposure gray image. For this threshold is calculated of gray image and it is utilized to clip the gray image into different images. And then this clipped image is individually equalized utilizing histogram equalization with discrete wavelet transform for the enhancement of the image.**

Index Terms—Exposure, DWT, Recursive HE.

I. INTRODUCTION

Enhancement of image is a process consist of group of methods that pursue to increase the visual presence or to transform the image to form a better suitable for examination by human or machine. Image enhancement betokens the upgrading of an image appearance by incrementing ascendance of some features or by decrementing ambiguity between different areas of the image. The aim of enhancement is to process an image so that the result is more congruous than the pristine image for a concrete application. Image enhancement is one of the most intriguing and visually appealing area in image processing.

Histogram equalization (HE) could be a technique to enhance the distinction of a picture as a result of its simplicity and facilitate of applying. Bar chart equalizations amend the general distinction of the image by levelling the density distribution and stretches the dynamic vary of grey levels. HE transform the grey calibers of pristine image to the calibers of increased image utilizing the additive density operate (ADO) of image. The disadvantage of HE's to transmute mean radiance of the image to level the center of the dynamic vary and leads to exasperating artifacts and intensity saturation effects. The downside HE technique makes it unsuitable for many of physical science applications used by shopper like TV and Cameras. [1]

Kapoor and Singh projected exposure predicated sub image bar chart exploit technique wherever exposure threshold is used to sub divide the image for improvement of pictures of low exposure. Promote Kapoor and Singh have in addition projected Median-Mean primarily based sub-picture cut bar chart levelling MMSICHE[2] calculation for image improvement, that right off the bat performs bar chart parcel in lightweight of middle force and later isolates every sub-histograms visible of mean power. Every of the four cut sub-histograms are adjusted on an individual basis. Low introduction footage have restricted dynamic vary transferal regarding poor quality. Footage having bar chart canisters focused towards the lower half or the darker dim levels have low power introduction whereas footage having bar chart containers focused towards the upper half or the brighter half have high force presentation and each category of images show poor differentiation. Albeit totally different techniques are accessible to produce food explicit issue of quality.

A. Discrete Wavelet Transform (DWT)

The essential thought of DWT in picture preparing is to multi-separate and break down the picture into sub-picture of various spatial area and autonomous recurrence locale. At the point when the initial picture is changed by DWT, the picture is isolated with DWT in four sub-band pictures: three recurrence parts of high (HL, LH and HH) and one recurrence part of low (LL, named estimated sub-picture). In Fig. 1, two level wavelet change procedure of the picture is appeared, LL is the estimate low recurrence part and HL, LH, HH are the flat high recurrence, the vertical high recurrence and the corner to corner high recurrence part individually.[4]

LL	HL
LH	HH

Fig. (1) Wavelet Decomposition

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The data of the first picture is spoken to by the vitality of the high-recurrence part (flat, vertical and inclining part) which is less, for example, the surface, edge, and so forth. The large portion of the vitality of the picture is thought by low recurrence part and speaks to an essential part and it can be deteriorated always. The vitality of the picture is diffused better and the picture power can be installed more grounded, and by utilizing wavelet change to break down the picture with the more levels. Henceforth, the calculation utilizes the wavelet breaking down level similar to possible.[5]

II. PROPOSED METHOD

Poor distinction pictures don't occupy complete dynamic vary. bar chart receptacles of an image is targeted toward a lower half or the additional foreboding dim levels have low force presentation although footage having bar chart canisters targeted toward the next half or the more promising half have high power introduction. The ability presentation of images will be extensively consigned as below exposed and over exposed. The rule consists of steps as follows, particularly Exposure threshold calculation, bar chart clipping and algorithmic bar chart equalization, DWT and IDWT. The every step is conferred within the following subsections:

A. Calculation of Exposure Threshold

An exposure threshold [6] represents the quantification of intensity exposure of the image. The image is divide into sub pictures in underneath and over exposed utilizing this parameter. The exposure worth is 0–1 that is normalized vary. If the image has majority of over exposed region then the worth of exposure for a specific image is quite 0.5 and inclines toward one and if this worth is a smaller amount than 0.5 and motility toward zero then image is containing majority of underneath exposed regions. In each cases image contains poor distinction and desires distinction improvement. Picture force introduction esteem can be ascertained as

$$exposure = \frac{1}{L}\frac{\sum_{k=1}^{L} h(k)k}{\sum_{k=1}^{L} h(k)} \qquad (1)$$

where h(k) is histogram of picture and L is add up to number of dark levels. Another parameter Xa (ascertained in Eq. (2)) identified with presentation is characterized, which gives the estimation of dark level limit that partitions the picture into under and over exposed sub pictures.

$$X_a = (1 - \text{exposure})\, L \qquad (2)$$

This parameter obtains a value of more preponderant or lesser than L/2 (gray level) for exposure value lesser or more preponderant than 0.5 for an image having a dynamic range 0 to L.

The exposure threshold X_a of perfect histogram is calculated as per equation (1). Two more exposure thresholds (X_{al} and X_{au}) are calculated for two individual sub histogram divided predicated on X_a. [7]

$$X_{al} = L\left[\frac{X_a}{L} - \frac{\sum_0^{Xa-1} h(k)k}{L\sum_0^{Xa-1} h(k)}\right] \qquad (3)$$

$$X_{au} = L\left[1 + \frac{X_a}{L} - \frac{\sum_{Xa}^{L-1} h(k)k}{L\sum_{Xa}^{L-1} h(k)}\right] \qquad (4)$$

B. Histogram Clipping

The histogram cutting is to avoid excess improvement prompting characteristic of picture's appearance. For constraining the upgrade rate, we have to restrain the main subsidiary of histogram or the histogram itself [9].The histogram canisters having the esteem more prominent than the cut-out edge are restricted to the limit (Fig.2).

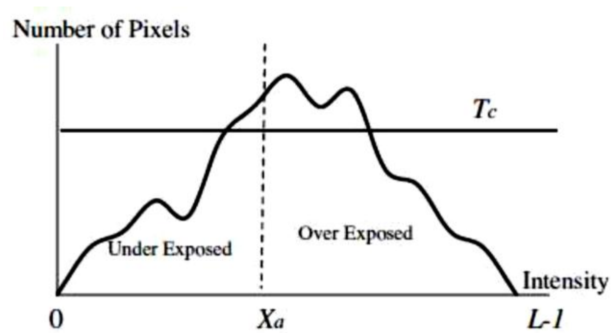

Fig. (2) Histogram Sub Division and clipping process.

The normal number of dark level is figured utilizing cutting limit events. The equation for section limit Tc is exhibited in (3) and (4) figures the cut histogram

The normal number of dark level is figured utilizing cutting limit events. The equation for section limit T_c is exhibited in (3) and (4) figures the cut histogram

$$T_c = \frac{1}{L}\sum_{k=1}^{L} h(k) \qquad (5)$$

$$h_c(k) = T_c \quad \text{for } h(k) \geqslant T_c \qquad (6)$$

where h(k) and $h_c(k)$ are original and clipped histogram. This method is computationally efficient and consumes lesser time for histogram clipping.

C. Histogram Sub Division and Equalisation

The histogram of original image is initially bisected using exposure threshold value X_a as calculated in (2). These sub histograms are decomposed into two smaller sub histograms where the individual exposure threshold X_{al} and X_{au} as calculated in (3) and (4) acts as separating purpose of sub histograms. The histogram sub division process results in four sub images W_{Ll}, W_{Lu}, W_{Ul} and W_{Uu} starting from grey level 0 to X_{al}–1, X_{al} to X_a–1, X_a to X_{au}–1, X_{au} to L-1. $P_{Ll}(k)$, $P_{Lu}(k)$, $P_{Ul}(k)$ and $P_{Uu}(k)$ are corresponding PDF of those sub images as outlined in equations (7–10)

$$P_{Ll}(k) = h_c(k)/N_{Ll} \text{ for } 0 \leq k \leq X_{al} - 1 \qquad (7)$$

$$P_{Lu}(k) = h_c(k)/N_{Lu} \text{ for } X_{al} \leq k \leq X_a - 1 \qquad (8)$$

$$P_{Ul}(k) = h_c(k)/N_{Ul} \text{ for } X_a \leq k \leq X_{au} - 1 \qquad (9)$$

$$P_{Uu}(k) = h_c(k)/N_{Uu} \text{ for } X_{au} \leq k \leq L - 1 \qquad (10)$$

N_{Ll}, N_{Lu}, N_{Ul} and N_{Uu} ar total range of pixels in sub images W_{Ll}, W_{Lu}, W_{Ul} and W_{Uu}, severally. $C_{Ll}(k)$, $C_{Lu}(k)$, $C_{Ul}(k)$ and $C_{Uu}(k)$ ar corresponding ADO of individual sub pictures and ADOs will be outlined as equations (11–14).

$$C_{Ll} = \sum_{k=0}^{X_{al}-1} P_{Ll}(k) \qquad (11)$$

$$C_{Lu} = \sum_{k=X_{al}}^{X_a-1} P_{Lu}(k) \qquad (12)$$

$$C_{Ul} = \sum_{k=X_a}^{X_{au}-1} P_{Ul}(k) \qquad (13)$$

$$C_{Uu} = \sum_{k=X_{au}}^{L-1} P_{Uu}(k) \qquad (14)$$

In the next step we equalize all the four sub histograms on an individual basis. The transfer functions for histogram equalization supported equations (7 – 14) may be outlined as equations (15–18)

$$F_{Ll} = X_{al} C_{Ll} \qquad (15)$$

$$F_{Lu} = (X_{al} + 1) + (X_a - X_{al} + 1) C_{Lu} \qquad (16)$$

$$F_{Ul} = (X_a + 1) + (X_{au} - X_a + 1) C_{Ul} \qquad (17)$$

$$F_{Uu} = (X_{au} + 1) + (L - X_{au} + 1) C_{Uu} \qquad (18)$$

F_{Ll}, F_{Lu}, F_{Ul} and F_{Uu} are the transfer functions used for equalizing the sub histograms severally. The image is produced by the combination of all four transfer functions.

D. Discrete Wavelet Transform

In DWT whole image is remodeled and compressed as one knowledge object in its place of block by block. Thus effective signal is rotten into two components, a close half (high frequency) and approximation half (low frequency).

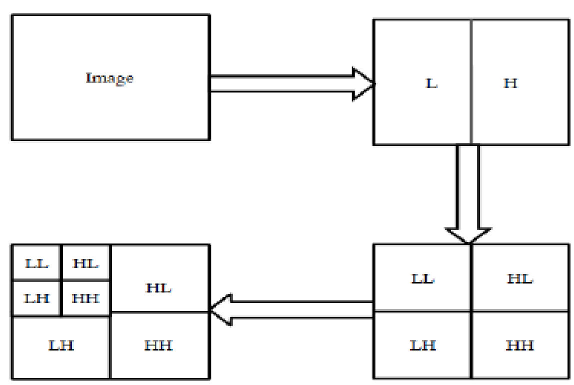

Fig. (3) Image after Two decomposition is applied

The steps needed to apply DWT on an image as shown below:

Step 1. The filter is applied on each row while pristine image is passed through high pass filter and low pass filter.

Step 2. At that point both the output of the picture l1 and h1 are amalgamated into

t1= [l1 h1].

Step 3. At that point t1 is down tested by 2.

Step 4. Presently, t1 is gone through high pass channel and low channel by applying channel on every section.

Step 5. Yield of step4 should be l2 and h2. At that point l2 and h2 are consolidated into t3= [l2 h2].

Step 6. Presently t3 is down tested by 2. This is our packed.

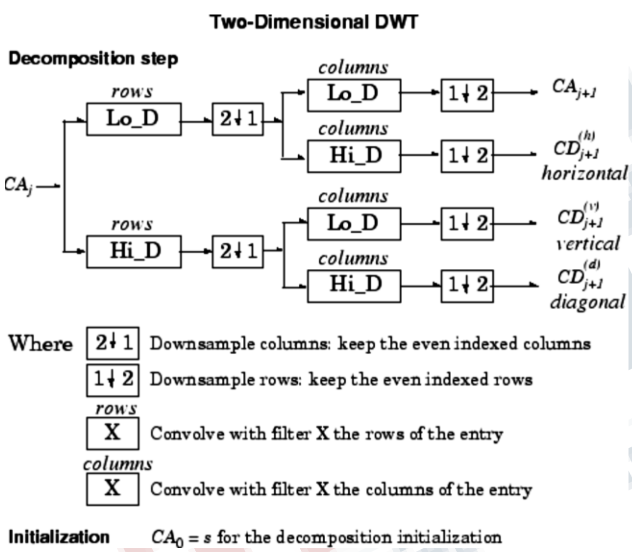

Fig. (4) Two dimensional DWT

Step 7. The IDWT is applied on the image which we get after the DWT to get a single image. [8]

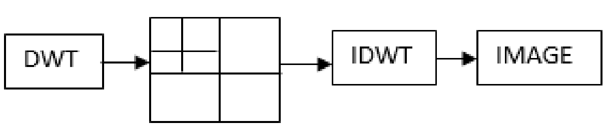

Fig. (5) Image we get after IDWT

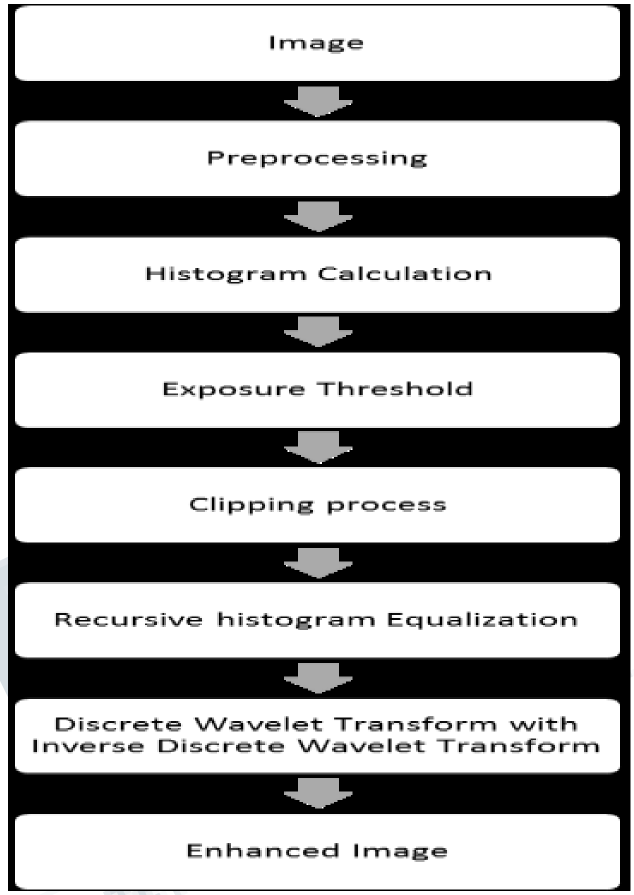

Fig. (6) Flow Diagram of proposed method

E. Algorithm of Proposed Method

Step 1: Calculate histogram h(k) of the image.

Step 2: Value of exposure and threshold X_a is computed.

Step 3: The clipped histogram $h_c(k)$ and the clipped threshold T_c is computed.

Step 4: The threshold X_a is used to clip the histogram into two sub histograms.

Step 5: Compute exposure thresholds X_{al} and X_{au} for lower and upper sub histograms and divide the sub histograms into further sub histograms using X_{al} and X_{au} as decomposing threshold, resulting in total four sub histograms.

Step 6: Apply the histogram balance on singular sub histograms and join the sub pictures into one picture.

Steps 7: Pass the picture through the DWT and afterward through IDWT to get the yield picture.

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III. IMAGE QUALITY MEASUREMENT PARAMETER

If you are using *Word,* use either the Microsoft Equation Editor or the *MathType* add-on(http:// www. mathtype .com) for equations in your paper (Insert | Object | Create New | Microsoft Equation *or* MathType Equation). “Float over text” should *not* be selected.

A. Entropy

E = entropy(I) returns E, a scalar esteem speaking to the entropy of grayscale picture I. Entropy is a factual measure of haphazardness that can be utilized to portray the surface of the information picture. Entropy is characterized as sum (p.*log2 (p)) where p contains the histogram checks came back from imhist. As a matter of course, entropy utilizes two containers for sensible exhibits and 256 receptacles for uint8, uint16, or twofold clusters. I can be a multidimensional picture. On the off chance that I has more than two measurements, the entropy work regards it as a multidimensional grayscale picture and not as a RGB picture.

B. Standard Deviation

S = std(A) restores the standard deviation of the components of An along the main cluster measurement whose size does not equipollent 1. On the off chance that A will be a vector of perceptions, at that point the standard deviation is a scalar. On the off chance that A will be a framework whose segments are erratic factors and whose lines are perceptions, at that point S is a line vector containing the standard deviations comparing to every segment. On the off chance that A will be a multidimensional cluster, at that point std(A) works along the primary exhibit measurement whose size does not equipollent 1, regarding the components as vectors. The extent of this measurement moves toward becoming 1 while the sizes of every single other measurement remain equipollent. Of course, the standard deviation is standardized by N-1, where N is the quantity of perceptions.

C. Variance

V = var(A) restores the change of the components of An along the main cluster measurement whose size does not equivalent 1.If A will be a vector of perceptions, the difference is a scalar. In the event that A will be a network whose sections are irregular factors and whose lines are perceptions, V is a line vector containing the changes comparing to each column. If A will be a multidimensional cluster, at that point var (A) treats the qualities along the principal exhibit measurement whose size does not equivalent 1 as vectors. The span of this measurement moves toward becoming 1 while the sizes of every single other measurement continue as before. The change is standardized by the quantity of perceptions 1 as a matter of course. On the off chance that A will be a scalar, var (A) returns 0. On the off chance that A will be a 0-by-0 exhaust exhibit, var (A) returns NaN.

IV. RESULTS

Result using the parameter is as follows

A. Using Entropy

Image Name	ESIHE METHOD	PROPOSED METHOD
1.	7.55337	7.8812
2.	7.39623	7.80202
3.	6.78799	7.80202
4.	6.60975	7.77135

B. Using Variance

Image Name	ESIHE METHOD	PROPOSED METHOD
1.	4753.92	5658.3
2.	3946.24	4769.4
3.	1638.46	4840.86
4.	1475.63	5248.94

C. Using Standard Deviation

Image Name	ESIHE METHOD	PROPOSED METHOD
1.	68.9487	75.2216
2.	62.8191	69.0609
3.	40.4779	69.5763
4.	38.414	72.4496

ISSN (Online) 2394-2320

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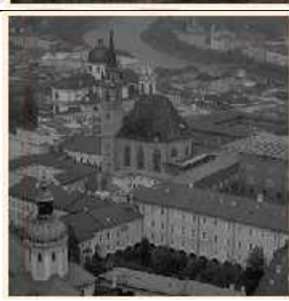
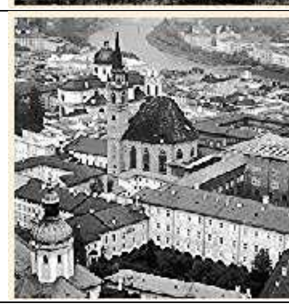
The result using the images of different type of method is shown below

	Original Image	ESIHE METHOD	PROPOSED METHOD
1			
2			
3			
4			

V. CONCLUSION

In this paper a method is given which is utilized to enhance the low exposure images efficiently. The histogram clipping is utilized with the histogram equalization and amalgamated with DWT to provide an enhanced image. The entropy, variance and standard deviation measures of the method limpidly show that it performs better than ESIHE methods.

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