# AUTOMATED CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZTION USING INTRINSIC DECOMPOSITION AND DUAL GAMMA CORRECTION

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***Abstract :***

Image enhancement is a technique to bring out the detailed which is hidden in an image that is to increase the contrast of that part of the image where the information of the image lies. An image can be enhanced by using different enhancement techniques. Even though the image enhancement technique enhance the contrast of an image in an effective and efficient way, they usually have some drawbacks like loss in information, noise amplification and over enhancement. In this paper, an algorithm is proposed for image contrast enhancement using CLAHE, Intrinsic Decomposition and Dual Gamma Correction. As image decomposition is a highly critical problem, on both reflectance and illumination layers we have implemented some conditions .To avoid this problem intrinsic decomposition is used. Dual gamma correction is used to enhance the pixel intensities. There are four quantitative measuring parameters such as total variation (TV), average mean brightness error (AMBE) , enhancement measure error (EME), CQE is used to measure the quality of the enhanced image.

*Index Terms* - **– CLAHE , Intrinsic Decomposition, Dual Gamma Correction, Illumination Layer, Reflectance Layer.**

## I.INTRODUCTION

Image contrast enhancement is a main method to enhance the visual quality of digital images. There are several causes of poor images such as poor images due to sensors , non uniform exposure, short shutter cycle and weak ambient light (weather conditions such as heavy clouds, fog and lack of sunlight and night scenes).These conditions leads to images with contrast distortions, color fading, and low intensity. Images captured under low light condition will have the characteristic of poor dynamic range, low contrast and strong noise. So, it is required to enhance the quality and contrast of the image. There are basically three types of image enhancement techniques [1]: Non linear transfer function based methods, histogram based methods and frequency domain methods. The non linear methods like gamma correction, algorithm mapping change directly the pixel values and effectively represents the properties of human visual system (HVS).Gamma correction changes the digital values of the image based on the comfort on human eye [1].

## II. IMAGE ENHANCEMENT

Image enhancement is a technique to highlight the specific feature of the image. The image background appearance of the original image is improved by image enhancement [3].This technique will not increase the information present in the image [2].Image quality can be increased by contrast manipulation, noise reduction, histogram equalization, filtering, edge crispening and sharpening. Image quality can be modified by performing the enhancement in order to make the image more understandable so that more amount of information can be extracted. Extraction of information is mainly based on the appearance of the image and the way the human eye perceives the image. Besides the image is being enhanced, the naturalness of the image should be preserved. Image enhancement has many applications such as computer vision, pattern recognition, medical imaging, remote sensing imaging and computational photography [1].

## II.I HISTOGRAM BASED TECHNIQUES

Histogram based techniques are classified as shown in figure 1.

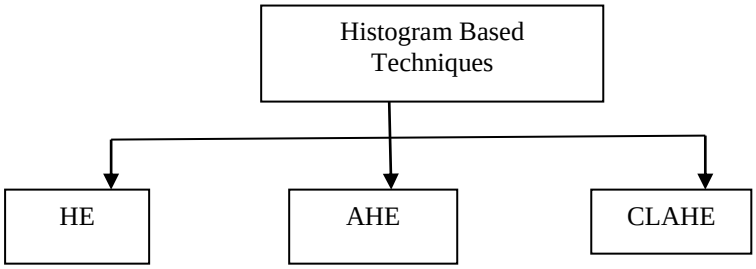



Fig1. Types of Histogram Based Techniques (6)

### *A. Histogram Equalization (HE)*

In HE, the gray image P(j) histogram can be mentioned as

…… (1) where

'j' indicates gray level of an image, '$n_j$' denotes the pixel number in the gray level 'j' , and 'Num' is the total number of the image pixels.

Based on P(j), histogram equalization is calculated as:

…… (2)

Where denotes the mapping function and 'T(k)' maps each pixel value 'k' of the input image into . 'L' is the dynamic range of the output image. HE causes over enhancement which result in unnaturalness and washout appearance [1].

### *B. Adaptive Histogram Equalization (AHE)*

It is a local enhancement technique which enhances the image's local contrast and more points of interest. At the same point of time information of all intensity ranges of the image can be viewed. In this technique various histograms of different parts of the image are processed, which are used to rearrange the brightness values of the image [7].In this technique contrast is improved based on the local area rather than entire image[3].

### C. *Contrast Limited Adaptive Histogram Equalization (CLAHE)*

It is also known as generalized form of AHE. This method computes the histogram corresponding to different parts of the image, then implies the HE to rearrange the brightness values of the image. The advantage of this technique is easy to use, simple calculations and gives good output in local areas of the image [10].

## III. EXISTING SYSTEM

In order to overcome the disadvantages of conventional HE[14] ,a Gaussian mixture model(GMM) is introduced for the purpose of modeling of intrinsic distribution at different intervals, different regions of image can be obtained through GMM[15]. For smoother results Bezier curve is used to modify the CDF.

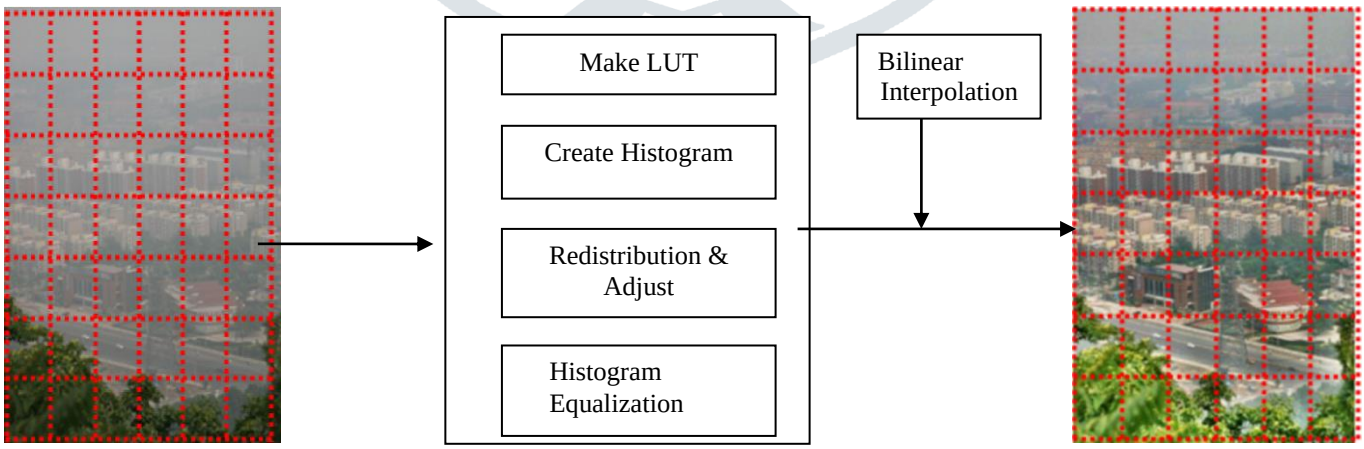



Fig 2.Existing System

## IV. PROPOSED METHOD

***Block Diagram:***

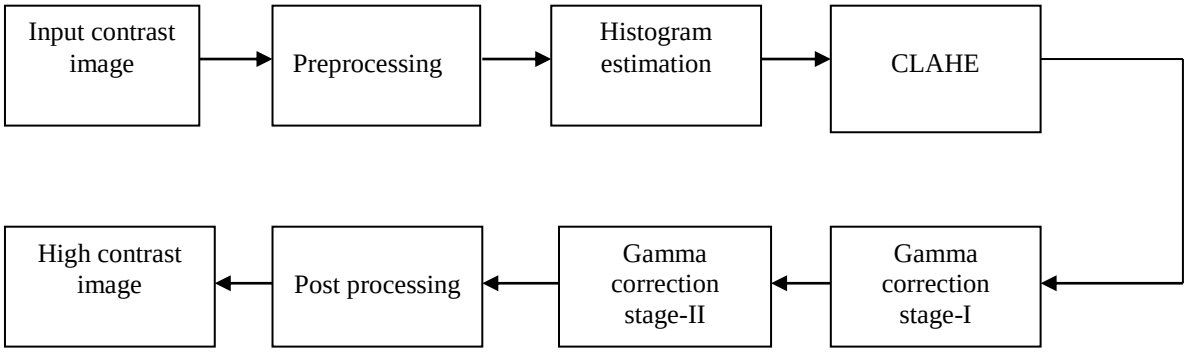



Fig 3.Block Diagram of Proposed System

- ***Intrinsic image decomposition:***

Intrinsic image decomposition aims to decompose an image into two layers namely reflectance layer and illumination layer. Illumination layer gives the information related to the amount of light absorbed by the image, where as reflectance layer gives the explanation related to intrinsic color of the image. The constraints that are posed to obtain better results are that, the neighborhood pixels with same color should have same illumination and reflectance values.
The respective equation is
V=L R (represents point wise multiplication)……. (5) where 'L' is the illumination layer, 'R' is the reflectance layer and 'V' is the output image.

- ***Dual gamma correction:***

Gamma correction is a type of power law transform, which is used to boost the intensity values. Gamma value lies between 0 and 1.This correction increases the pixel intensities whose gamma value is less than '1' and decreases the pixel intensities whose value is greater than '1'.

- ***Algorithm:***

The schematic block overview of the proposed image contrast enhancement algorithm is shown in fig (3)

1. First low contrast image is considered and it is subjected to the pre processing stage, where the original image is denoised and enhanced to improve its visual quality initially.
2. Next the Histogram of the pre processed low contrast image is computed and plotted.
3. After analyzing the histogram representation of the low contrast image, the Contrast Limited Adaptive Histogram Equalization is adopted.
4. Next first stage Gamma correction is performed.
5. Afterwards, second stage gamma correction is performed.
6. Finally the resultant image is given to post processing to get the final output image which is a high contrast image.

## V.RESULTS

***Parameters used:***

**1.Total variation:**

The statics of noise is measured by TV. In dark regions along with contrast noise is also enhanced. So it is required to evaluate noise exposures. TV can be calculated as:

$$TV = \frac{1}{(m-1)(n-1)}($$ ……. (6) Where 'm', 'n' indicates height and width of image is the pixel coordinate. An image has a high score in terms of noise indicates has a high score of TV.

**2. Average mean brightness error (AMBE):**

AMBE reflects the change of gray levels between the input image and the enhancement result.
AMBE can be calculated as

……..…… (7) Where and are the means of the original image and its enhanced result. Luminance measure can be obtained through this parameter which is directly related to average luminance. Better performance can be obtained through lower AMBE.

**3. Enhancement mean error (EME):**

The average ratio of maximum to minimum intensities in decibels is given by EME. It is given as

…….. (8) Where the image is segregated into blocks. 'c' is a small value. and are the maximum and minimum values in (k ,l) block.

**4. CQE:**

CQE is a measure consists of colorfulness, sharpness, and contrast as follows:

C…… (9)

- ***Experimental results***

Fig 5.1 Original Image

Fig 5.2 H channel image

Fig 5.3 S channel image

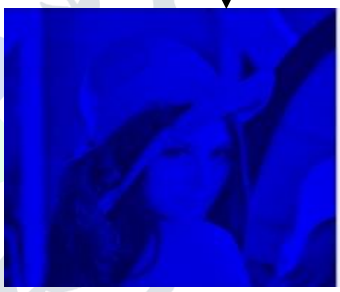


Fig 5.4 V channel image

Fig 5.5 Input image

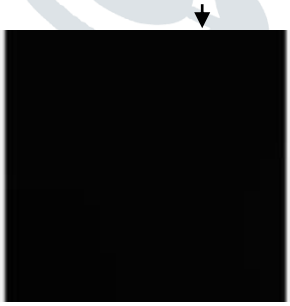


Fig 5.6 Reflectance image

Fig 5.7 Shading image

Fig 5.8 Illumination Adjusted Layer of 5.1

Fig 5.9 Integrated image

Fig 5.10 CLAHE image

Fig 5.11 CLAHE enhanced image

Fig 5.12 Combined HSV image

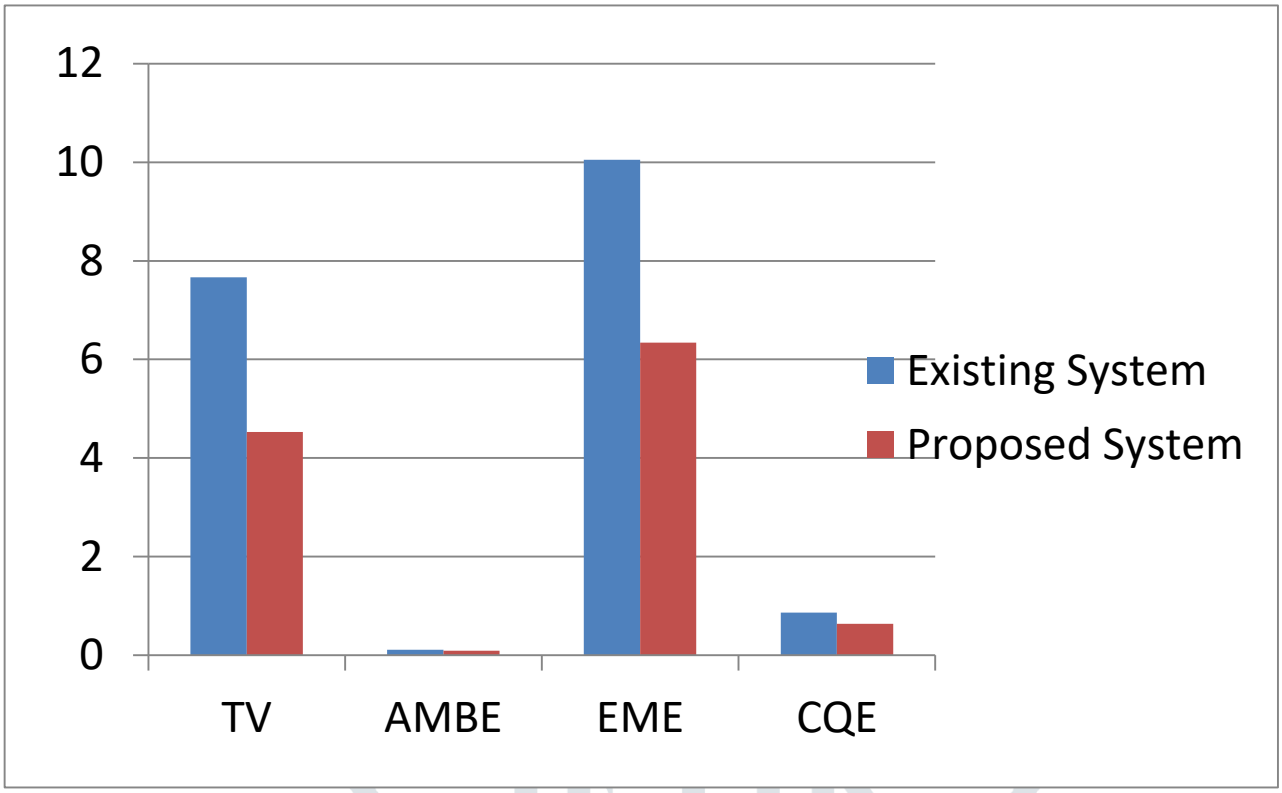
Fig 5.13 First stage gamma corrected image

Fig 5.14 Second stage gamma corrected image

Fig 5.15 High contrast image

***Results comparison:***

| PARAMETERS | EXISTING SYSTEM | PROPOSED SYSTEM |
|---|---|---|
| TV | 7.6679 | 4.5290 |
| AMBE | 0.1121 | 0.0906 |
| EME | 10.05 | 6.3405 |
| CQE | 0.8619 | 0.6341 |




## VI. CONCLUSION

In this paper automatic CLAHE for contrast enhancement of image has been proposed with intrinsic decomposition along with dual gamma correction. To enhance the contrast of the image by removal of tone distortion and over enhancement in CLAHE, dual gamma correction is introduced. Along with dual gamma correction intrinsic decomposition is issued to obtain the detailed analysis of the image by dividing it into illumination layer, reflectance layer there by resolving the loss of any kind of information from the image. The experimental results shows that, a low contrast image of Lena leads to high contrast image. Based on the quantitative parameters TV, AMBE, EME and CQE shows that the proposed method is better than existing system. The proposed system has many advantages such as preserving the brightness integrity of the image, avoids over enhancement problem of the image, it can work well for non uniform illumination enhancement. This method is robust with high efficiency with preserving naturalness and do not introduce any negative artefacts.

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