A comparison between SSR &MMSICHE techniques for Image Enhancement

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Abstract

Image enhancement is to improve the visuality and improve quality of image. It means apply a certain transformation to input image so that it gives better image than input image.Many images that are collectés from medical,satellite,electron microscopy are poor contrast and affected by noise.So ti is required to enhance the contrast & keep brightness constant .There are two technique to enhance the contrast one is spatial domain and second is frequency domain. The above technique gives a high quality image with better visualisation.

Keywords:-Image enhancement, Histogram equalization, Retinex, MMSICHE

1. INTRODUCTION

Human being can collect information using its five organ. Among all five organ visual information play a major role when compare with other sensing organ. Because by observing a particular object many information can be collected. But it required the object must be of good quality or its image captured in good lighting condition. If the image is not a good quality then it required to improve the quality of image by enhancement technique. Image enhancement is a combination of many of techniques that are helpful to improve the visual appearance of degraded image and to convert the image to a better quality without much loss of information. Previously various enhancement technique has been introduced like histogram equalization [1].Histogram equalization increase the mean brightness of image. Here the probability distribution function (PDF) is calculated. Then from PDF, Cumulative Density Function (CDF) is calculated by taking summation of PDF of each pixel. Then by multiplying each CDF with maximum gray value i.e. L-1 one gray level value mapped to the other gray level value. But histogram equalization only increase the dynamic range of image and quality is not better.

Other method for image enhancement based on frequency domain i.e. Homomorphic Filtering. Here the image reflectance(R) and illumination (I) is calculated .To separate each component logarithm of both component is taken. The Fourier Transform of the both component is calculated the the image is represented by frequency domain. Then inverse Fourier transform is calculated, and the exponential transform is calculated to get enhanced version of original image [2]. Other method is also based on homorphic filtering but by using sub-image technique for Face Identification [3].Here only two algorithm for enhancement is discussed 1) single scale retinex 2) Mean median based sub image Histogram Equalization is discussed. These two method discussed in section 2 &3. The different image enhancement parameter to measure quality of image i.e. PSNR, Pearson co-relation coefficient and brightness error, is described in section 3. The simulation result and parameter comparison table is mentioned in each section.

2. SINGLE SCALE RETINEX

Retinex image enhancement technique is for improving visibility [4]. It improve the visibility by changing the Dynamic range. Dynamic range is the ratio of maximum value to minimum value, in case of image Dynamic range of a scene is the ratio of brightest and darkest part of the scene. It is helpful to driver with poor vision at night and bad weather condition.

2.1 Retinex Algorithm

This algorithm estimates the spatial array of lightness value by using the following step:

1. Select a single pixel value ( ).
2. Randomly select a neighboring pixel (x_2).
3. Calculate the difference at two position.
4. The value calculated previously is added to accumulator register for position of(x_2) such that:

$$A(x_2) = A(x_2) + log(x_2) - log(x_1) \quad (1)$$

Where accumulator register for pixel (x_2).

5. Set the counter register for position x_2 and increment itand find the path.

6.The path is calculated by with random selection of a neighbor of pixel x_2 .The accumulator of position (x_i) on this path is updated by:

$$A(x_i) = A(x_i) + log(x_1) \quad (2)$$

7.For the retinex the center is defined as each pixel value and the surround is a Gaussian function. And it is given by:

$$R(x,y) = log[I(x,y)] - log[I(x,y) * f(x,y)] \quad (3)$$

Where I: input image and R: is the retinex output image fis the Gaussian filter defined as:

$$f(x,y) = kexp\left[-\frac{x^2+y^2}{\sigma^2}\right] (4)$$

Where σ is the standard deviation of the filter and controls the amount of spatial detail. K is a normalization factor that keeps the area under Gaussian curve.

2.1 Simulation Result

The below results are obtained using above single scale retinex algorithm:

Fig 1. Input image

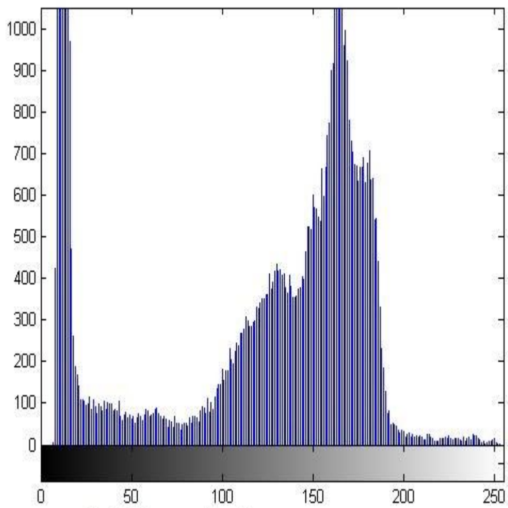

Fig 2. Histogram of input image

Fig 3. Enhance image using SSR

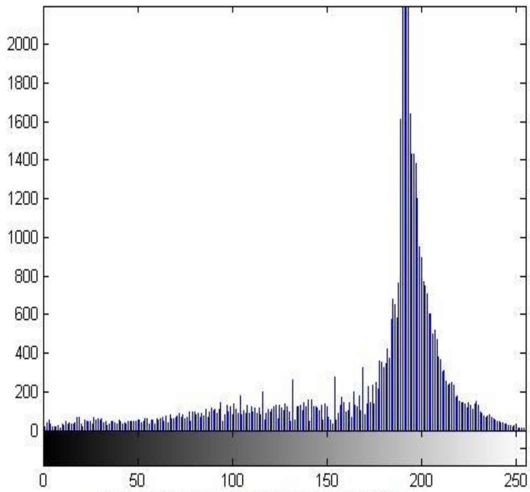

Fig 4. Histogram of enhance image after SSR

Here if we see (Fig.2) the histogram of original image it is not uniformly distributed but in the upper and lower part of gray scale distribution is more .But after processing the image through SSR technique we get a uniform distribution at some part (lower part and in the upper part of gray level distributionFig 4).

3. MEDIAN MEAN BASED SUB IMAGE CLIPPED HISTOGRAM EQUALIZATION

The algorithm consist of three steps first is median calculation, mean calculation and histogram clipping [5].

3.1 MMSICHE Algorithm

1.The median value x_m of image is calculated and then it will divide whole image into two sub image.Then each sub image mean is calculated that isx_{ml}, x_{mu}.

2.Then the $x_{ml}$and x_{mu}can be calculated as

$$x_{ml} = \sum_{k=0}^{x_m-1} p_l(k) * k \quad (5)$$

$$x_{mu} = \sum_{k=x_m}^{L-1} p_u(k) * k \qquad (6)$$

$$N = \sum_{k=0}^{L-1} h(k) \qquad (7)$$

Where L is the total no. of grey level. h (k) is histogram of image. p_l, p_u are individual PDF of two sub histograms of two sub image based on median value. N is number of sample. The fig.show how clipping and equalization is done :

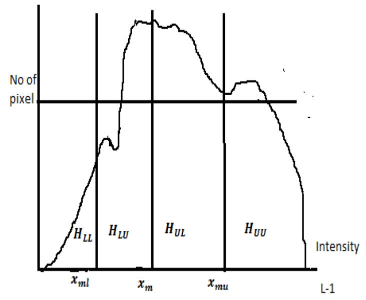

Fig 5.Processing histogram for clipping [5]

3.2 Histogram Clipping

The idea behind histogram clipping is to increase the enhancement rate to give natural appearance of the image. Here clipping Threshold is calculated (T_c) as the median of occupied intensity.

$$T_c = median[h(k)]$$
$$h_c(k) = T_c \quad for\ h(k) \geq T_c$$

h (k) and $h_c(k)$ are the original and clipped histogram.

3.3Histogram sub division and Equalization

Each sub- image mean x_{ml}, x_{mu} again divide the two sub-image.
So the sub-division process result in four sub-images $H_{LL}, H_{LU}, H_{UL}, H_{UU}$ and the range of each sub-image is from gray level 0 tox_{ml}; $x_{ml}+1$ to x_m ;x_{m+1} to x_{mu} and $x_{mu}+1$ to $L-1$.
Then each sub-image is equalized .
Then each sub-image is combine to result in a complete enhanced image.

Fig 6. Input image

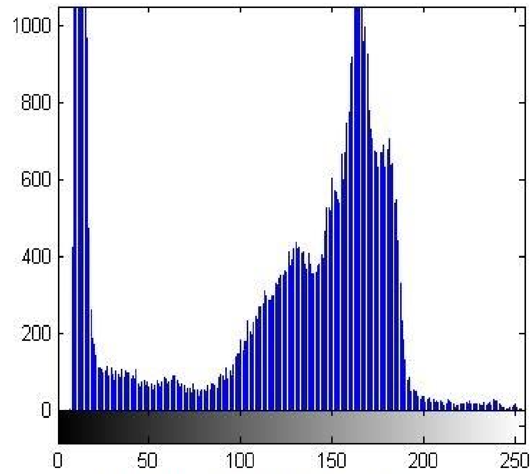

Fig 7. Histogram of original image

Fig 8 : Enhance image

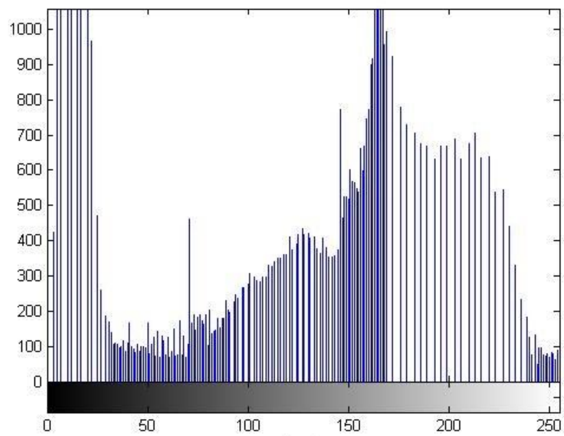

Fig 9: Histogram of enhance image

The above result of MMSCHI technique (Fig 9) show that almost uniform distribution in all range of gray scale.

3.4 IMAGE ENHANCEMENT PARAMETER:

To measure the effectiveness of Retinex algorithm and MMSICH we use three widely used metrics: PSNR, PCC and MSE. We will show briefly how to evaluate these matrix in the next section.

3.4.1 Peak Signal to Noise Ratio (PSNR)
PSNR is standard of reconstructed image quality and is an important measurement feature [6]. It is in db. Let f is the reference image and t is the test image both of same size (M*N) the PSNR between f and t is given by

$$PSNR(f,t) = log\ \log_{10}\frac{(L-1)^2}{MSE(f,t)} \qquad (8)$$

Where L is gray level & MSE (mean square error) is calculated as:

$$MSE(f,t) = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left(f_{ij} - t_{ij}\right)^2 \qquad (9)$$

Note the greater the PSNR the better output image quality.

3.4.2 Mean Squared Error (MSE)
It deals with the values obtained by calculating difference between estimated value and optimum values of estimated quantity. MSE quantifies the average of squares of the ‘’ errors’’. The higher value of MSE the better.

3.4.3 Pearson Correlation Co-efficient (PCC)
The Pearson product-moment correlation co-efficient is measure the correlation i.e. the strength of linear dependence between two variable x and y and a value between +1 and -1 inclusive

$$pcc = \frac{(n\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2] - [n\sum y^2 - (\sum y)^2]}} \qquad (10)$$

4 RESULT ANALYSIS

Here in above the parameter that show effectiveness of a enhancement algorithm .The three parameter is estimated for the SSR enhance image and MMSICH enhance image and it is represented in below table.

Table 1

Parameter	**PSNR(db)**	**MSE**	**PCC**
SSR	**11**	**0.0750**	**5.3951**
MMSICH	**22.15**	**0.035**	**6.49**

The result show that the peak signal to noise ratio is high in MMSICH and the PCC is high in this. So if we take any type image at any lighting condition then MMSICH will perform better.

References

[1] R.Garg, “Histogram Equalization Techniques for Image Enhancement,” International Journal of Electronics and communication Technology, Vol (2), 2011, ISSN: 2230-9543(Print). (journal style)

[2] P.padmaja,“An approach to color Image enhancement using Modified histogram”, International Journal of Engineering Trends and Technology,pp:4165-4172,Vol(4) ,2013

[3] K.Delac, “Sub-image Homomorphic filtering Technique for improving facial Identification under difficult Illumination condition,” International Conference on systems, signals and Image processing, 2006. (conference style)

[4] J.Mujumdar,“Retinex algorithm with reduced Halo Arti facts,”pp: 559-566, Vol(61),No. 6 , 2011. (Online published)

[5] K. Singh,“Image enhancement via Median-Mean Based Sub-image-clipped Histogram Equalization,”pp: 4646-4651, Optik 125, 2014.

[6] A.A.kandeel, "A study of a Modified Histogram Based Fast enhancement algorithm (MHBFE)," International Journal of signal & image processing, pp: 55-67, Vol (5) ,2014(Journal style).

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