Journal of Engineering Sciences
Vol 10, Issue 10, OCT/2019
ISSN NO:0377-9254

HYBRID ENHANCEMENT TECHNIQUES FOR LOW CONTRAST IMAGES

S.Velugonda Reddy
Assistant professor
Department of ECE
Krishna Chaitanya
Institute of Technology &
Sciences, Markapur
Mail-ID:
velugonda.sadula90@gmail.com

A.Prasad
Associate Professor
Department of ECE
Krishna Chaitanya
Institute of Technology &
Sciences, Markapur
mailsofprasad@gmail.com

K.Ranjith kumar
Associate Professor
Department of ECE
Krishna Chaitanya
Institute of Technology &
Sciences, Markapur
ranjit439@gmail.com

Abstract—Image enhancement is a tool used to increase image quality and visual perception. There are several methods to improve the visual perception of an image. Image enhancement includes point to point processing transforms, histogram processing, image smoothing and image sharpening methods to improve the visual perception of an image. In order to increase the quality generally global image enhancement transformations are employed , but it has some demerits that it ignore the local information of an image. Local information of an image is useful to analyze the image in the domains like the image taken from satellite, planetary bodies and medical images. Local information of an image is very useful for diagnosing a particular ailment. The brightness of the image may loss when only local enhancement or global enhancement is used. The enhancement of the image will be better if we use hybrid enhancement techniques that is combining of both local and global enhancement transforms. In this paper we presented a hybrid enhancement technique, includes both local and global enhancement transforms, which enhance the low contrast images. This technique was verified in MATLAB and the image quality metrics are also measured.

I. INTRODUCTION

Basically there are three needs for digital image processing. 1.Human visual perception, 2. Autonomous machine application, 3.Storgae and transmission. Out of these three human visual perception is an important one why because the details or objects of an image can be perceived clearly when the image has good quality. Contrast of an image is a vital factor that influence human visual perception. The difference between intensity values of a pixel with its neighbor pixels in an image is called as contrast. Contrast and difference of intensity values both are linearly proportional to each other that is more the difference value mean contrast is more. Obviously the image with more contrast has better quality. In general we need an image with high contrast only why because we can observe each and every minute detail of the image clearly. For example in medical applications it is very important to have minute details of image in order to analyze the problem and to provide treatment. The quality of an image can be improved and all the minute details can be perceived with the improvement of science and technology[1]. Over the years several methods are proposed to increase the visual perception of an image.

Contrast improvement is one of the pixel to pixel transformation method used to enhance an image. Contrast improvement methods can be divided into two categories are 1.Global methods 2. Local methods. The global method s will work on overall enhancement of the image but they fail to improve the local information of the image. The local methods focus on the local information the image but they fail to enhance overall appearance of the image. The technique we proposed in this paper will enhance both the local information and overall appearance of the image. The histogram equalization method is one of global methods used generally in order to improve overall appearance of an image. In [2] contrast improvement using Histogram equalization is presented. All the peaks in histogram are equalized separately in [3]. Histogram is one of the method that can be implemented in spatial domain. Applying some method or process directly on the pixels of the image is called as spatial domain processing. However applying of one method will not enhance the image as we expect. The enhancement level may vary from one type of image to another type of images.

In [4] various methods proposed in order to enhance the medical images. With these methods the bright parts of image are further brightened. The methods in [5] will enhance only dark regions of image without effecting the bright parts of the image. The methods presented in [6] provides solution to restore blurred images. Basically blurring will occur when image acquiring system is in motion or the object that we want to capture is in motion. Application of both global and local enhancement methods are present in [7] & [8] for

gray scale and color images respectively. We have used those methods with slight changes implemented in this paper and the quality metrics of an image like mean, variance and intensity enhancement factor are calculated, in general mean of an image describes about overall intensity of an image where as variance describes about contrast of an image. The results of proposed technique are compared with the results of histogram equalization.

The rest of this paper is describes about methods of image enhancement, the implementation of proposed technique, results and conclusion.

II. METHODS OF IMAGE ENHANCEMENT

Image enhancement can be carried out both in spatial domain and frequency domain. In spatial domain filtering the transforms are directly applied on pixels but in frequency domain filtering the methods are applied on frequency equivalent of the image. Image enhancement methods can be divided as local enhancement and global enhancement methods.

A. Local Enhancement method

The local details of an image can be elevated by using local enhancement methods. The local information is very useful in order to analyze the image. Local enhancement methods elevate those pixels which are not elevated by the global method. There are various local enhancement methods like un sharp masking [9], High boost filtering, histogram processing with statistical values etc. In this paper we have used un sharp masking method for local enhancement. In this method we will generate a window or mask by performing subtraction between original image and its smoothed version. After that the window is again added to original image by multiplying with a constant. Here the window contains edge information of original image. The total process can be summarized in the following steps.

1. Perform smoothing operation to input image.
2. Perform the Subtraction between smoothed image and input image to generate the window or mask.
3. Add the window to input image.

Assume the input image as f(u,v). After performing smoothing operation to original image we will get blurred image or smoothed image and denote it as b(u,v). Now the window is

$$w(u,v) = f(u,v) - b(u,v) \qquad (1)$$

By adding the window w(x,y) to the input image we will get the un sharp image as

$$h(u,v) = f(u,v) + k*w(u,v) \qquad (2)$$

in the above equation 'k' is a weighted constant and k>0. When the k=1, equation (2) performs un sharp masking and when k>1performs high boost filtering. A proper 'k' value should be selected by performing multiple iterations. Now h(x,y) i.e output of local method is given as input to the global method to improve overall clarity.

B. Overall Image Enhancement

The global enhancement concentrates on overall image intensity. The contrast of an image can be increased by adjusting gray level value each and every pixel in the image. There are different types of global enhancement methods like histogram matching, histogram equalization (HE), image sharpening by laplacian or gradient, pixel to pixel transformations and many other transformation methods like discrete cosine transform, discrete sine transform, and K-L transform etc. Among all of these, HE is the one of simple and frequently used method for overall enhancement of the image[9]. Histogram is one of the tool to understand about the visual clarity of an image. Histogram is nothing but a plot between gray level and number of pixel those have a particular gray level. That is histogram describes about count or number of pixels with same gray level in the image. If r_k indicates gray level of image then normalized histogram is given by

$$h(r_k) = \frac{n_k}{N * M} \qquad (3)$$

n_k- number of pixels with gray level r_k
N*M- total number of pixels

Normalized histogram of an image is nothing but probability density function if we consider gray level as random variable. It is observed that the image which has uniform histogram that image will have good visual perception. Uniform histogram means each gray level repeated equal number of times in the image. Now histogram equalization is the technique which modifies the histogram of image into uniform histogram. As we said the image with uniform histogram has good visual perception.

In histogram equalization the important thing is to select the transformation which modifies the histogram of input image. To get uniform histogram the transformation should satisfy two conditions. Those are

1. The transformation should be a monotonically increased function.
2. The range of gray levels should be same for both input and output images.

The pixels of input image are modified according to the following transformation equation [9].

$$z_k = L(r_k) = (R-1)\sum_{t=0}^{k} p(r_t)$$
$$= \frac{(R-1)}{N*M}\sum_{t=0}^{k} n_t \qquad (4)$$

where 'R' is the largest intensity level or value, L (r_k) is the transfer function and k = 0, 1, 2, 3, ..., R-1. So the pixel of output image is obtained by mapping each input pixel r_i to the new intensity value z_k. That is for every r_k gray level of input image there is a corresponding gray level z_k for output image.

III. PROPOSED TECHNIQUE

The scheme of proposed technique is as shown in figure1, where it includes both local and global enhancement methods for a dark image. The total method id summarized into four steps and are described below.

Step 1: Take a RGB color image and map it into hue, saturation and Intensity (HSI) color model and separate the intensity component from H and S components.

Step 2: Perform the local enhancement method as shown in equations 1 & 2 to elevate the local information of image.

Step 3: The output of step2 is given as input to global enhancement method to apply global image enhancement.

Step 4:Concatenate the components and remap it back to RGB color model.

In this algorithm first a low contrast image should be taken and map it from the red green and blue (RGB) color space to the HSI color space. From the HSI color space, the Intensity is taken to apply the algorithm. To improve the contrast of an image we should have color information and intensity information separately. Why because if we apply any transformation to color components then the color of the objects in the original image may change. That's why we will convert an image from RGB space to HSI color space. In HSI color space Hue and Saturation components have color information and where as Intensity component has luminance information. Now the un sharp masking method is performed for intensity component to elevate local details of image.

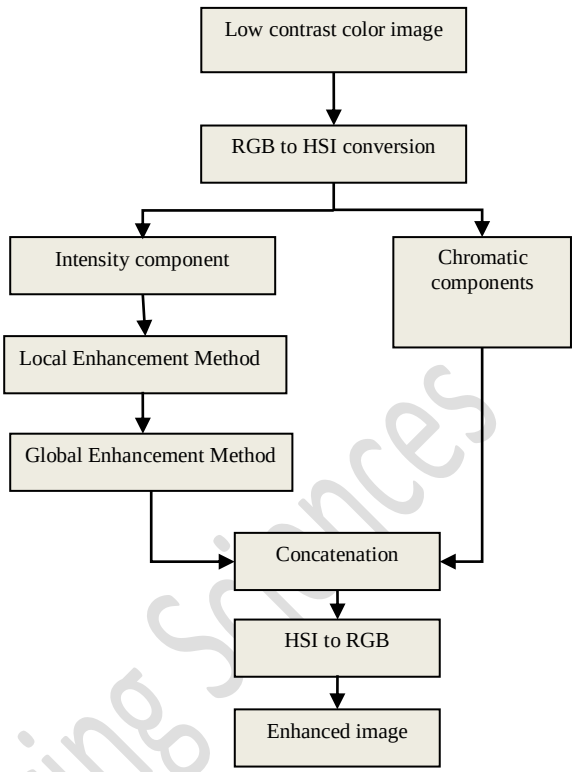

Fig. 1. Flow graph of the proposed technique

The global enhancement method will take output of un sharp masking as input. Here we used histogram equalization as our global enhancement method for stretching the contrast. In this we can use hybrid technique to enhance low contrast images.

IV. IMPLEMENTATION AND RESULTS

To observe the effects of the combinations of local and global enhancement methods of the images, the proposed technique is applied. In order to apply the proposed technique first we need to enhance the color image or digital color image and then convert in to the HSI color space. There are three different components exist in the image which are hue, saturation and intensity. We should perform image plane slicing on each and individual component. The chrominance of the image is mainly depends on hue and saturation and luminance is related to intensity, and it is also carries the radiance information and brightness of an image. So the total three components in an image, two planes are kept as it is without changing and the proposed technique is applied on intensity component.

By using un sharp masking method the local details such as edges are enhanced. In the process of obtaining enhanced image, enhancement method getting the edges information in the image is first step. At the end of this process we will get the local information of the image but less clarity in the overall picture brightness. To overcome this

problem the output of local enhancement passed through the global contrast enhancement method. This method employed here is histogram equalization which is explained in the above. The below figures some of the examples or outputs of the algorithm which is explained above.

i) Input Image ii) Output image

a) Water falls

i) Input Image ii) Output image

b) Play ground

i) Input Image

ii) Output image

c) City

Fig 2: Input and Enhanced images of proposed method

The image quality parameters also verified for the proposed technique. One of the important parameter for measure of enhancement is the Intensity Enhancement Factor (IEF). In order to find the IEF first find the enhancement of the input and then calculate the enhancement of output individually. IEF is defined as ratio of output image measured enhancement value to the input image measured enhancement value. The resultant of IEF value gives the good visual perception of the enhanced image. We also calculated the mean and variance of the different input original images and enhanced output images. As we know mean value indicates the overall intensity of an image and variance indicates the contrast of an image. A larger value of mean and variance gives the good quality of an image. The Table I contains the comparisons input and output images. In Fig.2 contains original images and the outputs of proposed algorithm enhanced images. All the results in the table-I and in figure 2 are carried out with help of MATLAB.

Table-I: Comparison between input and enhanced images

S.No	Image		Mean	Variance	IEF
1	Water falls	Input	0.1	0.0018	1.13
		Output	0.5	0.085	
2	Play ground	Input	0.234	0.07	1.14
		Output	0.5	0.084	
3	City	Input	0.42	0.0196	3.73
		Output	0.49	0.085	

The below figure shows the comparison between outputs of only global method and proposed algorithms.

a) Output of HE

b) Output of proposed algorithm

c) Output of HE

d) Output of proposed method

Fig 4: comparison between histogram equalization and proposed method

In the above figure a) and c) are the outputs of only histogram equalization and b) and d) are the outputs of proposed method. From above figure we can said that proposed method producing images with better quality than histogram equalization. Hence from the table-I and figure 4 we can said that the hybrid enhancement method is better than single enhancement method(histogram equalization).

V. CONCLUSION

In this paper by using MATLAB our proposed method is successfully executed. By combining both global and local enhancement methods the visual perception of an image is improved when compared with either only local or global enhancement methods. Here we first enhanced the local details of an image by using local enhancement method, which are ignored in case of global method. To increase the visual perception of the image further we passed the output of local method through global method. The resultant image has increased brightness along visual clarity to human eyes. This proposed model will work efficiently for most of dark images. It is useful to identify the very small information in images like medical, satellite and natural planetary images etc. The comparison between proposed and histogram equalization also done. The different global enhancement and local enhancement methods are used and verified their performance in different combinations of the global enhancement and local enhancement methods.

REFERENCES

[1] T. Celik and T. Tjahjadi, "Contextual and Variational Contrast Enhancement," IEEE Transactions on Image Processing, vol. 20, no. 12, pp. 3431–3441, 2011.

[2] S. D. Chen and A. R. Ramli, "Preserving brightness in histogram equalization based contrast enhancement techniques," Digital Signal Processing, vol. 14, no. 5, pp. 413–428, 2004.

[3] S. D. Chen and A. R. Ramli, "Contrast enhancement using recursive mean-separate histogram equalization for scalable brightness preservation," IEEE Transactions on Consumer Electronics, vol. 49, no. 4, pp. 1301–1309, 2003.

[4] S. Premkumar and K. A. Parthasarathi, "An efficient approach for colour image enhancement using Discrete Shearlet Transform," in IEEE International Conference on Current Trends in Engineering and Technology (ICCTET), pp. 363–366, 2014.

[5] L. Shyam and M. Chandra, "Efficient algorithm for contrast enhancement of natural images," Int. Arab J. Inf. Technol., vol. 11, no. 1, pp. 95–102, 2014.

[6] S. Chen and A. Suleiman, "Scalable Global Histogram Equalization with Selective Enhancement for Photo Processing," in International Conference on Information Technology and Multimedia, Malaysia, pp. 744–752, Nov. 2008.

[7] S. S. Pathak, P. Dahiwale, and G. Padole, "A combined effect of local and global method for contrast image enhancement," in International Conference on Engineering and Technology (ICETECH), pp. 1–5, Mar. 2015.

[8] Kambam Bijen Singh, Telajala Venkata Mahendra, Ravi Singh Kurmvanshi and Ch V Rama Rao "Image Enhancement with the Application of Local and Global Enhancement Methods for Dark Images" in International Conference on Innovations in Electronics, Signal Processing and Communication (IESC), april 2017

[9] C. Rafael Gonzalez and R. Woods, "Digital Image Processing," 3rd Edition, Pearson Publication, 2002.