Medical Image Enhancement Using GMM: A Histogram approach

Ms.Dhanashree V. Patil, Mrs. Anis Mulla, Ms. Swaleha B.Chougale

* Annasaheb Dange College of Engineering & Technology, Ashta, Tal-Walwa Dist-Sangli

Abstract- In todays world visual information is becoming more important aspect.Human also relies very much on visual information.The visual information is represented by using digital images or videos.Digitalis images mostly suffer from poor image quality, particularly lack of contrast and presence of shading and artifacts due to the deficiencies in focusing lighting, specimen staining and other factors also.Because some features of images are hardly detected by eye in an image,images can be transformed before display.Image enhancement is a digital process-ing method which does its best to improve image vision and make the image adaptable to be processed by computer.

Contrast enhancement is also necessary because current softcopy display devices are inca-pable of displaying as many different discernible levels of luminance as can be recorded in a digital image.

Medical imaging is a leading role in modern diagnosis and contrast enhancement of medical image is useful in helping radiologist or surgeons to detect pathologic or abnormal regions. Enhanced medical images are desired by a surgeon to assist diagnosis and interpretation because medical image qualities are often deteriorated by noise and other data acquisition devices, il-lumination condition etc .Also targets of medical image enhancement are mainly to solve the problems of low contrast and high level noise of medical image.

General Terms- Gaussian Mixture Modeling algorithm, Histogram Generation.

Index Terms- Image, Image Enhancement.

I. INTRODUCTION

An image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is an image, like video frame or photograph, and output may be an image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image processing basically includes three steps:1:Techniques that decompose an image into high and low-frequency signals for manipulation 2:Transform-based-techniques 3:Histogram modification.

Out of these, first two techniques are computationally difficult however histogram modi-fication technique is easy due to their straightforward and intuitive implementation tech-niques.

II. LITERATURE SURVEY

a)Turgay Celik and Tardi Tjahjadi proposed ,an adaptive image equalization algorithm which automatically enhances the contrast in an input image[1]. The algorithm uses Gaussian Mixture Model to model the image gray level distribution and the intersection points of the Gaussian model are used to model the dynamic range of the image into input gray level intervals. The dominant Gaussian component and the cumulative distribution function of the input interval is utilized to generate the contrast equalized image by transforming pixels gray levels in each input interval to the appropriate output gray level

b)J. Mukherjee and S. Mitra suggested that,the display of color image depends upon three fun-damental factors that is its brightness, its colors and its contrast[2]. The proposed algorithm in this paper presents a simple approach for computing scaling of DCT coefficients by the constant factor in the block which automatically improves all three components of image enhancement that is its brightness, its contrast as well as the preservation of colors in enhanced images.

c) Eunsung Lee, Sangjin Kim, Wonseok Kang, Doochun Seo, and Joonki Paik,proposed an al-gorithm which computes brightness-adaptive intensity transfer functions using the low-frequency luminance component in the wavelet domain and transforms intensity values according to the transfer function[3].

d) Shih-Chia Huang, Fan-Chieh Cheng, and Yi-Sheng Chiu presented an automatic transfor-mation technique that improves the brightness of dimmed images via the gamma correction and probability distribution of luminance pixels[4]. To enhance video, the proposed image en-hancement method uses temporal information regarding the differences between each frame to reduce computational complexity. Experimental results demonstrate that the proposed method produces enhanced images of comparable or higher quality than those produced using previous state-of-the-art methods.

e) S.Agaian, B. Silver, and K. Panetta proposed three methods of image enhancement: 1) Logarithmic transform histogram matching 2) Logarithmic transform histogram shifting 3) Logarithmic transform histogram shaping using Gaussian distributions[5]

f) Haidi Ibrahim and Nicholas Sia Pik Kong proposed subregions histogram equalization[6]. This method partitions the image based on the smoothed intensity values, which are obtained by convolving the input image with a Gaussian filter.

g) T. Arici, S. Dikbas, and Y. Altunbasak proposed Framework based image equalization tech-nique for image contrast enhancement[7]. It adjusts noise robustness, white/black stretching and mean brightness i.e it manages different aspects of contrast enhancement. Contrast of image or video can be improved without introducing visual artifacts that decreases the visual quality of an image.

h) Dr. Muna F. Al-Samaraie and Dr. Nedhal Abdul Majied Al Saiyd proposed a novel method for enhancing and sharpening medical color digital imagesd[8]. Methods of image enhance-ment based on wavelet transform were proposed. More high-frequency information cannot be obtained only through multi-scale wavelet transform.This paper concludes that the proto-type enhancement procedure and novel enhancement procedure indicated that proceeding with Laplacian filtering technique provide a more experiment results than other techniques

III. NEED OF WORK

- Images with sufficiently high contrast can be improved as like gray-level images.
- Proposed method is applied on medical images in order to improve their visual quality. e.g if image contains several regions with different X-ray attenuation characters then image enhancement becomes a necessity.
- Histogram equalization method is applied to measure the improved results.

IV. PROPOSED WORK

4.1 Scope:

The above literature survey concludes that,

- Image processing is an important aspect of today's world which is achieved by performing different operations on it. Image enhancement is required for improving visualization of any image so that improved image can be easily viewed by user.
- Large no of image enhancement techniques are empirical and require interactive proce-dures to obtain proper results of quantifying criteria for image enhancement.
- Proposed approach automatically enhances contrast in an input image by using Gaussian Mixture Modeling method.
- Proposed method will produce encouraging results in achieving the brightness preservation and contrast improvement of medical images

3.2 Methodology:

3.2.1 System architecture

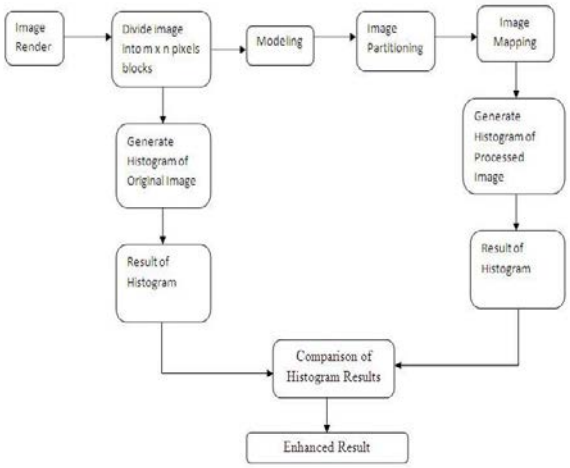

Figure 1: System Architecture

Figure 1 shows architecture of proposed system, in which The data set contains medical images such as x-rays, MRI etc. As shown in fig.1, the image is extracted from the database. It is divided into m x n pixels block and histogram of input image is generated. For histogram generation linear contrast stretching method is used. The results are calculated from the histogram of original image. The result contain different features of an image such as color of image, location angle of the image on histogram etc.

On the other side, Gaussian mixture modeling is applied on it's input image, which is an divided image. Gaussian mixture modeling includes Image modeling, Image partitioning and Image mapping. In image modeling, Gaussian models data distribution in terms of linear mix-ture of different Gaussian distributions with different parameters. Using partitioning technique the intersection points are selected from all possible intersections between the Gaussian com-ponents. Image mapping performs mapping of intervals of original image with dynamic range of the image. After applying the Gaussian mixture modeling on the image, the histogram of processed image is generated.Finally, comparison of histogram of original image and enhanced image is to be done.

V. THE MODULES OF THE PROPOSED WORK

Module 1: Processing an original image

The extracted image is divided into number of blocks of pixels. The image dividation will generate number of pixel points regarding the features of the original image such as im-age intensity, its angle of location etc. The Histogram of the original image is generated using linear contrast stretching method. Linear contrast stretching linearly expands the original dig-ital values of the image data into a new distribution. By expanding the original input values of the image, the total range of sensitivity of the display device can be utilized. Linear con-trast enhancement also makes subtle variations within the data more obvious. These types of enhancements can be applied to remotely sensed images with Gaussian or near-Gaussian his-tograms,where all the brightness values fall within a narrow range of the histogram and only one mode is apparent.

Module 2: Implementation of Gaussian Mixture Modeling method

1.Image Modeling:

Gaussian mixture is used to model any data distribution in terms of linear mixture of Gaussian distribution with different parameters. Gaussian modeling is used to portion the distribution of input image into mixture of different Gaussian components. These compo-nents are used to adjust the different parameters of the image. The gray-level distribution ,say p(x), of the input image X can be modeled as a density function composed of a linear combination of N functions using Gaussian modeling as in equation (1)

$$p(x) = \sum_{n=1}^{N} P(w_n)p(x|w_n) \quad (1)$$

wher e,

$p(x|w_n)$is n^{th} component density and

$P(w_n)$is the priority of data points generated from component w_n

2. Image Partitioning:

Using Figueiredo-Jain(FJ) algorithm, which will be used to adjust number of compo-nents during estimation of an image, all intersection points between Gaussian components that fall within dynamic range of input image and significant intersection points that are used for dynamic range representation is calculated i.e. significant intersection points are selected from all possible interactions between Gaussian components. The intersection points between Gaussian components say w_m and w_n are found by solving equation (2)

3.Image mapping:

Image mapping performs mapping of the intervals of original image with dynamic range of output image. The mapping of input image and enhanced image is done using Cumulative distribution function (CDF).

Cumulative Distribution Function is used as, suppose F1() and F2() are two functions. F1() is used for original image and F2() is used for enhanced image, then for each gray-level G2 for an output image Y and gray-level (G1) for an input image X for each Gaussian component is found where,

Module 3: Histogram Generation of Processed Image

An image obtained after Gaussian Mixture Modeling will be an enhanced image.Features of the enhanced image are extracted and histogram of processed image is generated.

Module 4: Result Comparison

The histogram of input image is compared with the histogram of processed image. For histogram comparison, HSV (hue, saturation, and value)is used which considers the x-location ,y-location and the angle of the pixel. The pixel angle is defined in the range of [0 to 2]. Gaussian mixture modeling uses different Gaussian components hence the angle of the pixel in the input image will be at low level as compared with enhanced image.

VI. EXPERIMENTAL SETUP

In this system, we generated the histogram of the original image and the histogram points are stored in a table. On the same image GMM method is applied in order to enhance the quality of

$$P(w_m)p(x|w_m) = P(w_n)p(x|w_n) \quad (2)$$

image.In order to enhance the quality of an image,image Equalization and contrast enhancement facility is provided. We can enhance upto 100% contrast of an imag.After applying GMM on an image , histogram of trained image is also generated.

Finally, histogram of original image and trained image are compaired with each other.The comparision of two histogram shows the better enhanced image.The work is implemented using c#.net and SQLquery.

VII. RESULTS

Here, we have shown the result of work.

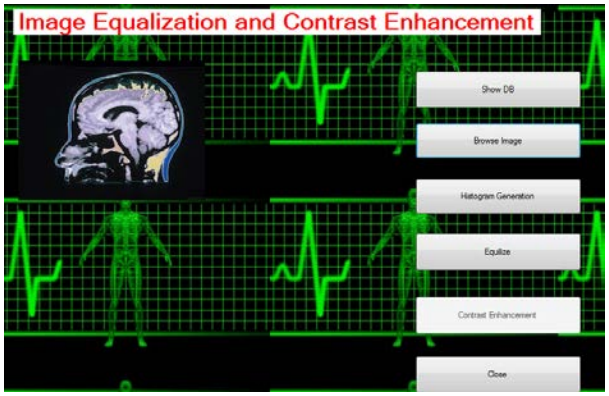

Figure 2: Loading an image from dataset

As shown in Figure 2., Image is loaded from the dataset. Dataset contains set of medical images which are used for enhancement purpose.

$$F1(G1) = F2(G2) \quad (3)$$

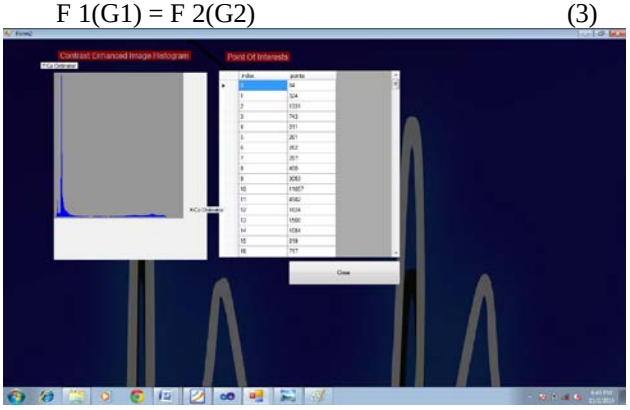

Figure 3: Histogram of an original image with its interest points

After loading an image from the dataset, histogram of original image is generated as shown in Figure 3. It also calculates its points of interests.

Figure 4: Equilized image.

Original Image is qualized in order to improve quality of an image as in figure 4.

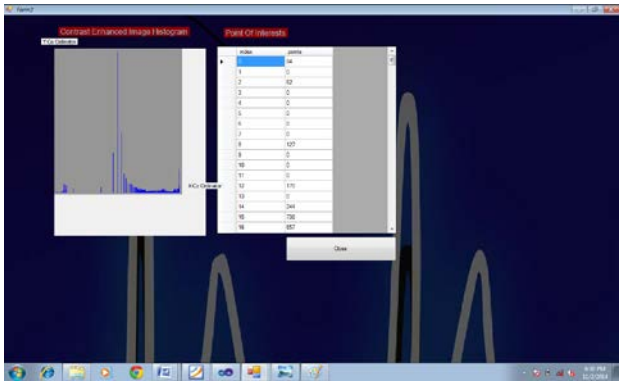

Figure 5: Histogram of an Equalized image

It generates histogram of an equalized image along with its points of interest as shown in Figure 5.

Figure 6: Contast Enhancement in %

It increases the contrast of an image. We can enhance upto 100% contrast of an image as in figure 6.

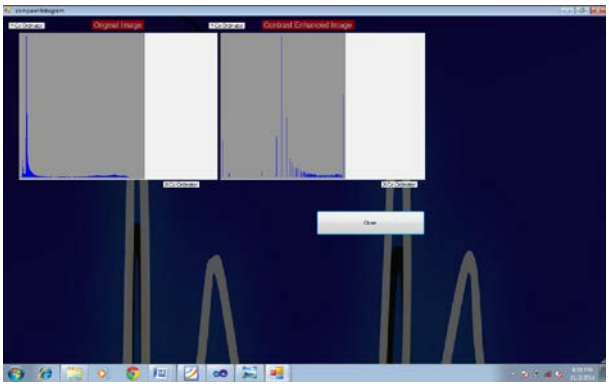

Figure 7: Comparision of two histograms

It gives comparision of an original image histogram and enhanced image histogram.

Figure 8: Enhanced image successfully stored in database

The quality enhanced image is stored into the database as in above figure 8.

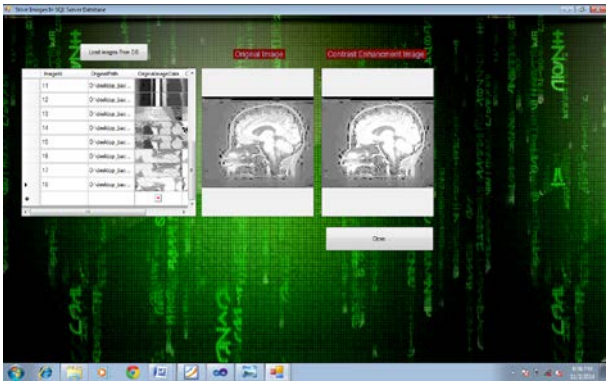

Figure 9: Database view of original image and enhanced image

In SQL database, original image and enhanced image is stored.

While improving the quality of an image, it does not change the quality of an original image. This system can work out on any type of image.

ACKNOWLEDGEMENT

I would like to thanks my guide Prof.A.N.Mulla for her valuable and constructive comments. I would also like to thanks Ms.Swaleha B. Chougale,Faculty of Annasaheb Dange College of Engineering & Technology, Ashta for her valuable support.

REFERENCES

[1] Turgay Celik and Tardi Tjahjadi , "Automatic Image Equalization and Contrast Enhance-ment Using Gaussian Mixture Modeling," IEEE Trans. Image Processing, vol. 21, no. 1, January 2012.

[2] J. Mukherjee and S. Mitra, "Enhancement of color images by scaling the DCT coefficients," IEEE Trans. Image Processing,vol. 17, no. 10,October 2008.

[3] Eunsung Lee, Sangjin Kim, Wonseok Kang, Doochun Seo, and Joonki Paik, "Contrast Enhancement Using Dominant Brightness Level Analysis and Adaptive Intensity Trans-formation for Remote sensing Images," IEEE Geoscience and remote Sensing Letters,vol-10,January 2013.

[4] Shih-Chia Huang, Fan-Chieh Cheng, and Yi-Sheng Chiu ,"Efficient Contrast Enhance-ment Using Adaptive Gamma Correction With Weighting Distribution," IEEE Trans. Image Processing,Vol-22,No-3,March 2013

[5] S. Agaian, B. Silver, and K. Panetta , "Transform coefficient histogram based image en-hancement algorithms using contrast entropy," IEEE Trans. Image Processing,vol. 16, no. 3,March 2007.

[6] Haidi Ibrahim Nicholas Sia Pik Kong, "Image Sharpening Using Sub-Regions Histogram Equalization," IEEE Trans. On Consumer Electronics,Vol.55,No-2,May 2009.

[7] T. Arici, S. Dikbas, and Y. Altunbasak, "A histogram modification framework and its application for image contrast enhancement," IEEE Trans. Image Processing,vol. 18, no. 9,September 2009.

[8] Dr. Muna F. Al-Samaraie and Dr. Nedhal Abdul Majied Al Saiyd, "Mediacl Colored Image Enhancement using wavelet Transform followed by image sharpening," Ubiquitous Com-puting and Communication Journal.

AUTHORS

First Author – Ms.Dhanashree V. Patil, Annasaheb Dange College of Engineering & Technology, Ashta, Tal-Walwa Dist-Sangli, crazydhanu14@gmail.com
Second Author – Mrs. Anis Mulla, Annasaheb Dange College of Engineering & Technology, Ashta, Tal-Walwa Dist-Sangli. mulla.anis@gmail.com
Third Author – Ms. Swaleha B.Chougale, Annasaheb Dange College of Engineering & Technology, Ashta, Tal-Walwa Dist-Sangli. swalehachougale09@gmail.com