Modified Method for Efficient Contrast Enhancement of Image Using Homomorphic Filter

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Abstract: **An image is defined as an array, or a matrix, of square pixels arranged in rows and columns. Image processing is a method of converting an image into digital form and performs some operation on it, in order to get an improved image. This paper proposes a new method for efficient contrast enhancement of an image. In image processing low contrast image analysis is a challenging problem. Low contrast digital images reduce the ability of observer in analyzing the image. Histogram based techniques are used to enhance contrast of all type of medical images. The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. Here we propose a new method. In proposed method, we initially modify the histogram of input image using a histogram modification function and then we apply HE method for contrast enhancement on this modified histogram. After that we use homomorphic filtering for image sharpening and then to minimize the difference between input and processed image mean brightness, we normalize it.**

Keywords: **Contrast Enhancement, Histogram Equalization,Histogram Modification, Fourier Transformation, High Pass Filter,Homomorphic Filter.**

I INTRODUCTION

In digital image processing contrast enhancement techniques areimportant for both human and computer vision. Image processing is a method to convert an image into digital form and perform some operations on it, in order to extract some useful information from it.Whenever an image is converted from one form to another, some degradation occurs at the output. All such degradation can occurs while performing some operation such as digitizing, transmitting, scanning etc. Hence the output image has to undergo a process called image enhancement. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background. Contrast is determined by the difference in the colour and brightness of the object with other objects. Histogram based image enhancement is very popular technique to enhance contrast of an image. Histogram equalization is a method of contrast adjustment using the image's histogram. In HE we stretch high frequent intensities over high range of gray levels to achieve comparatively more flat histogram. This flattering causes the overall enhancement of contrast of the input image. So the image required further processing, in proposed paper histogram modification is used to overcome disadvantages of HE.

This paper is organized into 6 sections. Section 1 gives an overview of the paper. Section 2 gives a comparative analysis of the different contrast enhancement technique. Section 3 describes proposed method for enhancement contrast of an image. Conclusion is made in section 4. Section 5 and section 6 cover the acknowledgement and references.

II IMAGE ENHANCEMENT TECHNIQUE

Image enhancement technique can be divided into two broad categories:

Spatial based domain image enhancement :-

Spatial based domain image enhancement works directly on pixels. The main advantage of spatial this technique is that they are simple to understand and the complexity of these techniques is low which favors real time implementations.

Spatial domain methods can again be classified into two broad categories:

- Point Processing operation:

The simplest spatial domain operations occur when the neighborhood is thepixel itself.Used primarily for contrast enhancement.

- Spatial filter operations:

Filtering is used to modify or enhance an image. Filtering is a neighborhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighborhood of the input pixel.

Advantages: simple to understand and the complexity of these techniques is low which favors real time implementations.

Disadvantages: These techniques generally lacks in providing adequate and robustness requirements.

Frequency based domain image enhancement:-

Frequency based domain image enhancement is used to describe the analysis of mathematical functions with respect to frequency and operate on the transform coefficients of the image, such as Fourier transform. The basic idea is to enhance the image by manipulating the transform coefficients.

Frequency domain methods can again be classified into three categories:

- Image Smoothing
- Image Sharpening
- Periodic Noise reduction by frequency domain filtering

Advantages: low complexity of computations, ease of viewing and manipulating the frequency composition of the image.

Disadvantages: it cannot simultaneously enhance all parts of image very well and it is also difficult to automate the image enhancement procedure

III PROPOSED METHOD

In proposed method, we initially modify the histogram of input image using a histogram modification function and then apply HE method for contrast enhancement on this modified histogram. After that use homomorphic filtering for image sharpening and then to minimize the difference between input and processed image mean brightness, normalize the image.

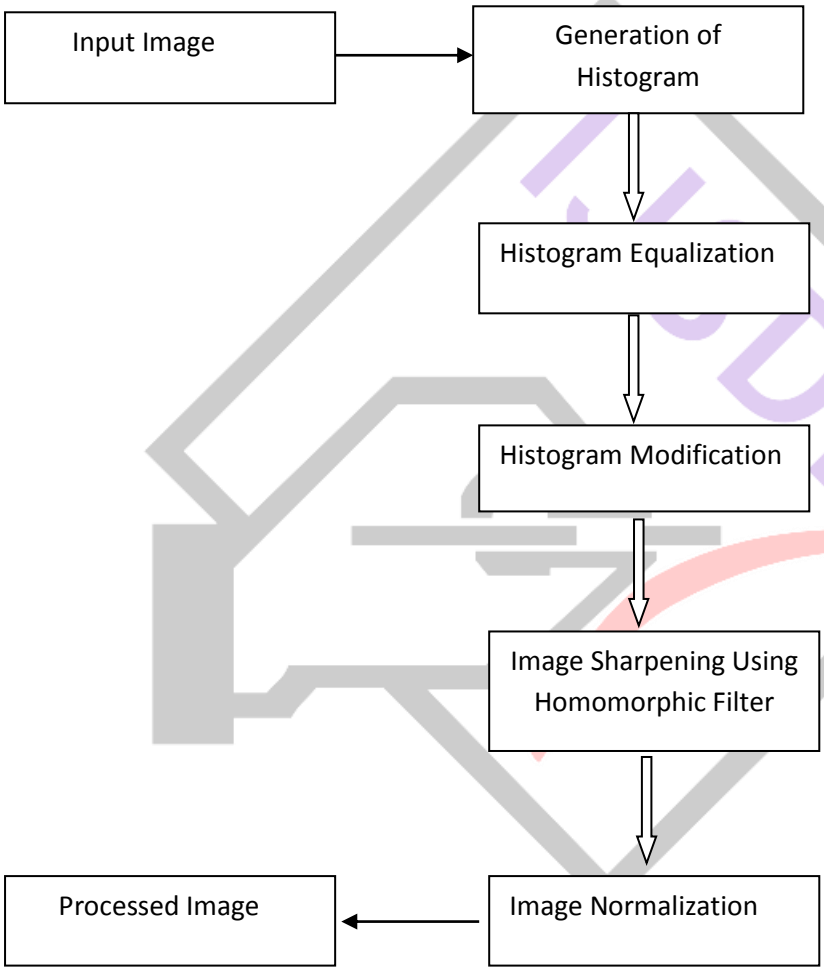

Figure 1: Proposed Method

The input to the system is in the form of a digital image.

The proposed approach consist of following steps:

- Input Image
- Generation Of Histogram
- Histogram Modification
- Histogram Equalization
- Homomorphic Filtering
- Image Normalization

Algorithm

Input: Accept digital image as input.

Output: Display the required image as the output.

Step 1: Accept the input image (in digital form).

Step 2: Generate histogram of input image.

Step 3: Perform histogram modification on input image.

a) Take the value of power low function.
b) Modify, histogram of input image using power low function.

Step 4: Apply histogram equalization on output of step 3.

Step 5: Perform homomorphic filtering

a) Use illumination-reflectance model

Step 6: Perform image normalization.

Step 7: Enhanced image is displayed as output.

In the proposed method we use equalized histogram as desired histogram in histogram modification (step 4).

A. GENERATION OF HISTOGRAM:

The horizontal axis of the graph represents the tonal variations, while the vertical axis represents the number of pixels in that particular tone. Histograms plots how many times gray level occurs.

For example

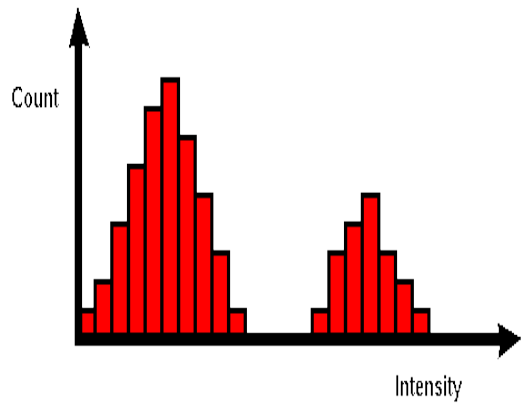

Figure 2.Histogram

How it Works: The image is scanned in a single pass and a running count of the number of pixels found at each intensity value is kept. This is then used to construct histogram.

B. HISTOGRAM MODIFICATION

Many image processing operations result in changes to the image's histogram. The class of histogram modifications which we consider here include operations where the changes to pixel levels are computed so as to change the histogram in a particular way. Here we want to convert the image so that it has a particular histogram that can be arbitrarily specified. Such a mapping function can be found in three steps:

- Equalize the histogram of the input image
- Equalize the specified histogram
- Relate the two equalized histograms

C. HISTOGRAM EQUALIZATION (HE)

One of the most popular global contrast enhancement techniques is histogram equalization (HE). Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. HE assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. It improves contrast and the goal of HE is to obtain a uniform histogram

In terms of histograms, the output image will have all gray values in “equal proportion” .

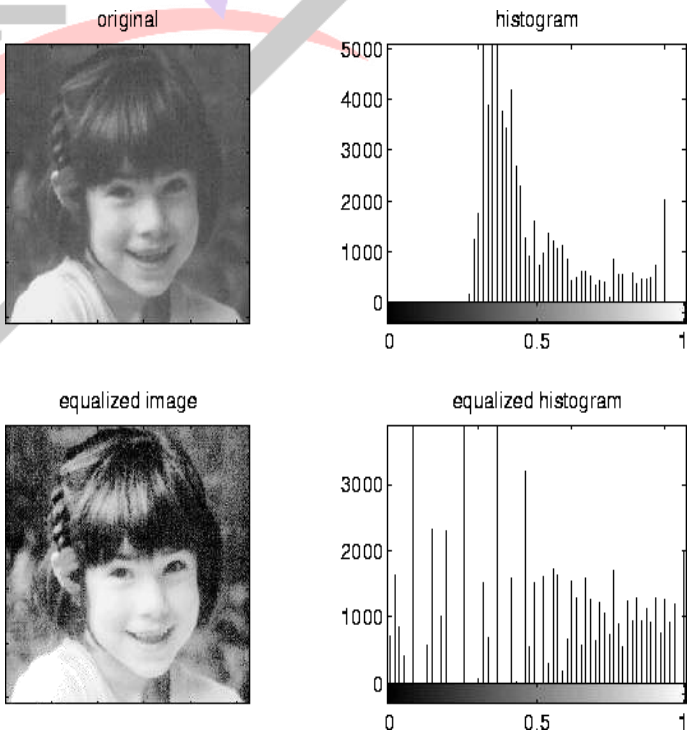

Figure 3: Histogram Equalization of an image

Advantages

- Simple and less complex

Disadvantages

- The brightness of an image is changed after the histogram equalization.
- It may increase the contrast of background noise.

D. HOMOMORPHIC FILTERING

The frequency filter process an image in the frequency domain.
Application of this type of filter contains following steps:

1. Transform the image into the fourier domain.
2. Multiply the image by the filter.
3. Take the inverse transform of the image.

E. IMAGE NORMALIZATION

In image processing, normalization is a process that changes the range of pixel intensity values. In more general fields of data processing, such as digital signal processing, it is referred to as dynamic range expansion. The purpose of dynamic range expansion in the various applications is usually to bring the image, or other type of signal, into a range that is more familiar or normal to the senses, hence the term normalization. Often, the motivation is to achieve consistency in dynamic range for a set of data, signals, or images to avoid mental distraction or fatigue.

IV CONCLUSIONS

Image enhancement and information extraction are two important components of digital image processing. Image enhancement techniques help in improving the visibility of any portion or feature of the image suppressing the information in other portions or features. Information extraction techniques help in obtaining the statistical information about any particular feature or portion of the image.

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