Contrast Enhancement Technique

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Abstract - Contrast is the visual difference from we can distinguish the object from its background and the other objects. For better human interpretation of images and higher perceptual quality, contrast enhancement becomes active research topic since early days of digital image processing. In this paper, some low contrast images are addressed which results the poor visual effect. In the low contrast images, the various objects cannot be distinguished clearly. Some image contrast enhancement techniques for low contrast images are reviewed. This technique gives better result than other techniques and their PSNR value is high & MSE is low. The experimental results show that the proposed enhancement method gives better results.
This paper proposed an algorithm that can improve the contrast of the images and preserve the details of the image.

Keywords – Histogram, Contrast, Histogram Equalization, Entropy, Image Processing

I. INTRODUCTION

Image processing is a way to perform some operations on an image, to get an enhanced image and to extract some useful and meaningful information from it. It is a type of signal processing in which we provide an image as input as output we may get may be image or characteristics/features associated with that image. It can be defined by the mathematical function f(x, y) where x is a horizontal co-ordinate and y is the vertical co-ordinate. The value of f(x, y) at any point gives the pixel value at that point of an image.

Purpose of Image Processing

The main purpose of Image processing for Visualization, Image sharpening and restoration. Image retrieval, Measurement of patterns, Image. Visualization is used to observe those objects which are not visible. Image sharpening and restoration is used for creating a better image. Image retrieval – is used to seek for an image of interest. Measurement of patterns for measuring the different objects in an image. Image Recognition to distinguish the objects in an image.

Application of Image Processing

Image processing has a broad spectrum of applications and can be surveyed using domains where images are used.

The field of digital image processing has continuously expansion in recent few years. The usefulness of this technology can be seen in many different disciplines covering medicine through remote sensing[20]. Image processing can be used in different fields like medical applications, digital cinemas, color processing, Watermarking [11], Pattern Recognition[23], Sonar, Robotics, Radar, Automated visual inspection in aerospace, food, textile [9]. The advances and wide availability of image processing hardware has further enhanced the usefulness of image processing.

Contrast can be explained as is the difference in visual properties that makes an object (or its representation in an image) discernible, from other objects and the background. In visual perception of the real world, contrast is determined by its difference in the color and brightness of the object and other objects within the same field of view.

In other words, it is the difference between the darker pixel and the lighter pixel of the image, if it is big the image will have high contrast and in another case the image will have low contrast.[10]

Contrast is the scale of difference between black and white in your images. Without contrast we do not have an image because we wouldn’t be able to find the differentiation between light and dark then everything will be seen as black, white or a single shade of gray.

High Contrast Image

High contrast image is that image in which high contrast will exhibit a full range of tones from black to white, with dark shadows and bright highlights. If
one shoot in bright sunlight, one will produce images that are ‘contrasty’. Typically, high contrast images will enjoy strong, bold colors and textures will be emphasised.

**Low Contrast image**

A low contrast image is that image in which there is no great difference between its lights and darks. And we can say it might looks flat or dull. Photos that one take in the fog or mist are perfect examples of low contrast images.

**Image Enhancement**

Image enhancement is a processes which consist of a collection of techniques that try to improve the visual appearance of the image or to transformed the image to a form better suited for analysis by a human or machine [10]. The process of manipulating or converting the image so that result is more suitable and useful than the original for a specific application. Image Enhancement technique is used in order to get the high contrast image.

The image enhancement is technique for the improvement of an image appearance by increasing dominance of some features or by decreasing ambivalence between different regions of the image[6].

The aim of image enhancement is to improve the visibility of low-contrast features while suppressing noise. The sharp contrast of edges and the subtle tone of surfaces in an image are interpreted as high perceptual quality. But in various conditions, such as fog, poor illumination, low grade imaging sensor, etc., can make an image look faded and blurry[6].

So the Image processing contrast enhancement techniques are proposed and used, to fully utilize the dynamic range of the raw sensor data and generate a more appealing and informative image.

**Histogram Equalization**

Histogram equalization is a way of adjusting the image intensities to get the enhance contrast.

Let $f$ be a given image and can be represented as a $mr$ by $mc$ matrix of integer pixel intensities ranging from $0$ to $L - 1$. $L$ is the number of possible intensity values that is $256$. Let $p$ denote the normalized histogram of $f$ with a bin for each possible intensity. So

$$p_n = \frac{\text{number of pixels with intensity } n}{\text{Total no of pixels}}$$

$n = 0, 1, ..., L - 1$.

The Histogram Equalization method is to design a transformation $T(\cdot)$ such that the gray value in the output is uniformly distributed in $[0, 1]$. It also known as histogram flattening. Histogram equalization can be explained as approach in which histogram can be by spreading the gray level areas.

**Methods for histogram equalization**

There are many different types of histogram equalization algorithms that are cumulative histogram equalization, normalized cumulative histogram equalization, and localized equalization. Here is a list of different histogram equalization methods[9]:

- Histogram expansion
- Local area histogram equalization (LAHE)
- Cumulative histogram equalization
- Par sectioning
- Odd sectioning

**Entropy** is the statistical measurement of randomness of image that are used to characterize the texture of the input image. Entropy can be defined as

$$\text{Entropy} = -\sum(p_n \cdot \log_2(p_n))$$

where $p_n$ contains the histogram counts. Entropy use two bins for the logical arrays and $256$ bins for double arrays. Image can be a multidimensional image. If image have more than two dimensions, then the entropy function treats that image as a multidimensional grayscale image not as an RGB image.

**PSNR** is an engineering term used to describe the ratio between the maximum power of the signal and the power of noise that affects the fidelity of its representation[7]. Signals have a very wide dynamic range, PSNR is usually defined in terms of the logarithmic decibel scale[20].

PSNR is mainly used for measuring the quality of recreation of lossy compression codecs [9]. The signal is the original data, and the noise is the error introduced by compression. On comparing compression codecs, PSNR is an approximation to human perception of reconstruction quality. Higher the PSNR value generally shows that the reconstruction is of higher quality.
II. LITERATURE REVIEW

Recently, there have been significant research works on Contrast Enhancement. This section covers the literature survey of the work of the paper.

Raj P* and Nagpal S [1] defines the problem of low contrast in the images. Image from low illumination source or due to some other reasons the image may be of low contrast which results in poor visual appearance. In these type of images the various objects present in the image cannot be distinguished clearly and can not be used for the desired purpose. For these images there is a need to improve the contrast of the image for a better visual effect. This paper proposed an algorithm that helps in improving the contrast of the images and preserve the details of the image. This algorithm will preserves the details of the image as well as the colors of the object to a larger extent.

Ms. K.T.Chalekar, Prof. T. Yengantiwar[2] proposed different image contrast enhancement techniques for low contrast images are surveyed, like histogram equalization, adaptive histogram equalization, contrast stretching and contrast limited adaptive histogram equalization etc. The conventional histogram equalizations methods usually reserved in excessive contrast enhancement. This paper describes the problem of over enhancement and various techniques are identified for effective contrast enhancement.

Raju, Dwarakish and D. Venkat Reddy[3] proposed different histogram equalization based methods are surveyed and compared with the quality of image using the Image quality measurement (IQM) tools such as Absolute Mean Brightness Error (AMBE) to preserve the brightness and Peak Signal to Noise Ratio (PSNR) to evaluate contrast enhancement.

Suman Thapar, Shevani Garg [4] proposed Morphology and its operations. It is used in the field of contrast enhancement. Top-Hat and Bottom Hat are two operations in morphology which are used for the image contrast enhancement. PSNR metric can be used to check peak signal to noise ratio in every enhanced image produced as result of various image contrast enhancement techniques.

M.Aarthly1, P. Sumathy [5] proposed the three various techniques of expansion which are dynamic range expansion, linear contrast expansion and symmetric range expansion. Each technique have its own specific strength and weakness. For the colored images linear contrast expansion is used. These all methods help in easy study of histograms and helps in image enhancement.

Nicholas Sia Pik Kong, Haidi Ibrahim, and Seng Chun Hoo [6] proposed some of the HE based methods. These methods are generally fall into three main categories of HE, namely Mean Brightness Preserving HE (MBPHE), Bin Modified HE (BMHE), and Local HE (LHE).

Manvi, Rajdeep Singh Chauhan, Manpreet Singh [7] proposed General framework of histogram equalization for the image contrast enhancement is discussed. In this framework, contrast enhancement is treated as an optimization problem that minimizes the cost function. Histogram equalization is an technique for contrast enhancement. Whether, conventional histogram equalization (HE) methods usually gives results in excessive contrast enhancement, which in turn gives the processed image an unnatural look. By introducing specifically designed penalty terms, the level of contrast enhancement can be adjusted; noise robustness, white/black stretching and mean-brightness preservation may easily be incorporated into the optimization.

Kanika Kapoor and Shaveta Arora [8] proposed the histogram equalization approach of gray-level images is extended for colour images. The acquired image is converted into HSV (Hue, Saturation, Value). The image is then decomposed into two parts by using exposure threshold and then equalized them independently. Over enhancement is also controlled in this method by using clipping threshold. For measuring the performance of the enhanced image, entropy and contrast are calculated.

Mr. Salem Saleh, Alamir, Dr. N.V Kalyankar, Dr. S.D.Khamitkar [9] proposed attempts to undertake the study two types of the contrast enhancement techniques, linear contrast techniques and non-linear contrast techniques. In linear contrast techniques applying three methods, Max-Min contrast method, Percentage contrast method and Piecewise contrast technique. Non-linear contrast techniques applying four contrast methods, Histogram equalization method, Adaptive histogram equalization method, Homomorphic Filter method and Unsharpe Mask. in the Homomorphic Filter method applying by using two type of filter, Low Pass Filter (LPF) and High Pass Filter (HPF); this applying to choose the base guesses for contrast enhancement image.

using contrast stretching method. Pixels are stretched within the non-outlier range from the input image. Higher quality images with less noise were produced.

REFERENCES


