Digital Image Enhancement and Histogram Processing

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Abstract : Image enhancement is the first step in digital image processing. The aim of image enhancement is to improve quality of an image for human viewers. In recent years, digital images have come to play an important role in medical diagnosis and many more scientific applications. An image histogram is an analytic tool used to measure the amplitude distribution of pixels within an image. By analyzing the distribution of pixel amplitudes, you can gain some information about the visual appearance of an image. A high-contrast image contains a wide distribution of pixel counts covering the entire amplitude range. A low contrast image has most of the pixel amplitudes congregated in a relatively narrow range.

Keywords: histogram, histogram processing, image enhancement.

I. INTRODUCTION

The histogram of a digital image with gray levels in the range [0, L-i] is a discrete function h(rk)= nk, where r k I the h th gray level and nk is the number of pixels in the image having gray level rk. . It is common practice to normalize a histogram by dividing each of its values by the total number of pixels in the image, denoted by n. Thus a normalized histogram is given by p(rk)= nk /n, for k= 0,1…. L-1. Note that the sum of all components of a normalized histogram is equal to 1.Histogram are the basis for numerous spatial domain processing techniques. Histogram manipulation can used effectively for image enhancement.[1]

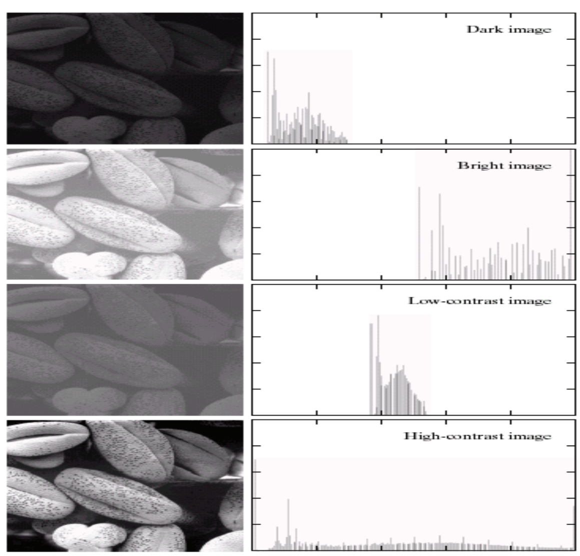

Fig.1 four basic image type: dark, light, Low contrast, and their corresponding histogram.

II. Shape of histogram

There are different shapes for too dark, too bright, low contrast and high contrast images. Figure 2 shows shape for dark image. The shape of dark image is slanting towards the origin. Figure 3 is indicating shape for bright image. The shape of bright image is slanting opposite towards the origin. Figure 4 is shape for low contrast image, which is central in position. Figure 5 show shape for enhanced images, which is equally distributed.

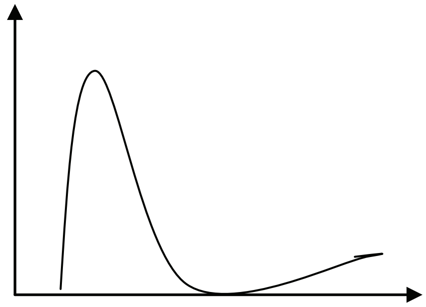

Fig. 2 Shape of dark image

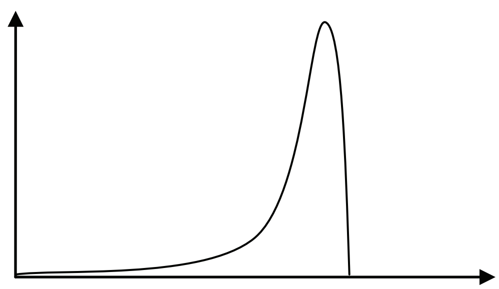

Fig. 3 Shape of bright image

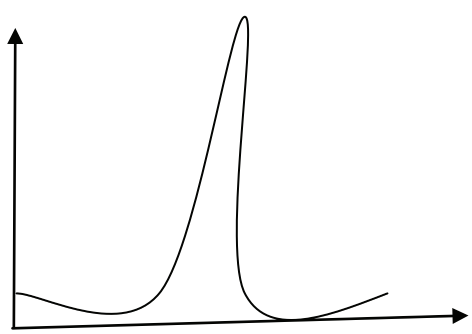

Fig. 4 Shape of low contrast image

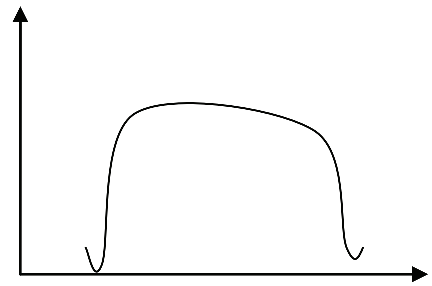

Fig. 5 Shape of good quality image

III. SPECIFYING THE HISTOGRAM

The Histogram object accumulates the histogram information. A histogram counts the number of image samples whose values lie within a given range of values, or "bins." The source image may be of any data type.

The Histogram contains a set of bins for each band of the image. These bins hold the information about gray or color levels. For example, to take the histogram of an eight-bit grayscale image, the Histogram might contain 256 bins. When reading the Histogram, bin 0 will contain the number of 0's in the image, bin 1 will contain the number of 1's, and so on. The Histogram need not contain a bin for every possible value in the image. It is possible to specify the lowest and highest values that will result in a bin count being incremented. It is also possible to specify fewer bins than the number of levels being checked. In this case, each bin will hold the count for a range of values. For example, for a Histogram with only four bins used with an 8-bit grayscale image, the number of occurrences of values 0 through 63 will be stored in bin 0; occurrences of values 64 through 127 will be stored in bin 1, and so on. The Histogram object takes three parameters:

1) Nubbins: An array of nits, each element of which specifies the number of bins to be used for one band of the image. The number of elements in the array must match the number of bands in the image.

2) Low Value: An array of floats, each element of which specifies the lowest gray or color level that will be checked for in one band of the image. The number of elements in the array must match the number of bands in the image.

3) High Value: An array of floats, each element of which specifies the highest gray or color level that will be checked for in one band of the image. The number of elements in the array must match the number of bands in the image.

IV. HISTOGRAM EQUALIZATION (HE)

Histogram equalization (HE) has proved to be a simple and effective image contrast enhancement technique. However, it tends to change the mean brightness of the image to the middle level of the gray-level range, which is not desirable in the case of images from consumer electronics products.

Histogram equalization techniques provide a sophisticated method for modifying the dynamic range and contrast of an image by altering that image such that its has a desired shape. Unlike contrast stretching histogram equalization operators may employ non-linear and non-monotonic transfer functions to map between pixel intensity values in the input and output images. Histogram equalization employs a monotonic, non-linear mapping which re-assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities (i.e. a flat histogram). This technique is used in image comparison processes because it is effective in detail enhancement and in the correction of non-linear effects introduced by, say, a digitizer or display system.

Histogram Equalization has proved to be a simple image contrast enhancement technique. However, it tends to change the mean brightness of the image to the middle level of the gray level range. [2], [3].

Contrast enhancement is an important area in image processing for both human and computer vision. It is widely used for medical image processing and as a preprocessing step in speech recognition, texture synthesis, and many other image/video processing applications [4], [5]. Different methods have already been developed for this purpose [2] - [4] Some of these methods make use of simple linear/nonlinear gray level transformation functions [1] while some of the others use complex analysis of different image features such as edge ,connected component information [6] and so on. A very popular technique for contrast enhancement of images is histogram equalization (HE) [1], [5], [6]. It is the most commonly used method due to its simplicity and comparatively better performance on almost all types of images. [6], HE performs its operation by remapping the gray levels of the image based on the probability distribution of the input gray levels. Many researches have already been done on histogram equalization and many methods have already been proposed .

V. Global Histogram Equalization (GHE):

Global Histogram Equalization uses the histogram information of the entire input image for its transformation function. Though this global approach is suitable for overall enhancement, it fails to adapt with the local brightness features of the input mage. If there are some gray levels in the image with very high frequencies, they dominate the other gray levels having lower frequencies. In such a situation, GHE remaps the gray levels in such a way that the contrast stretching becomes limited in some dominating gray levels having larger image histogram components and causes significant contrast loss for other small ones.

Global Histogram Equalization (GHE) Suppose input image f (x, y) composed of discrete gray levels in the dynamic range of [0, L-1] [1].

VI. Local histogram equalization (LHE)

Local histogram equalization [3] can get rid of such problem. It uses a small window that slides through every pixel of the image sequentially and only the block of pixels that fall in this window are taken into account for HE and then gray level mapping for enhancement is done only for the center pixel of that window. Thus, it can make remarkable use of local information also. However, LHE requires high computational cost and sometimes causes over-enhancement in some portion of the image. Another problem of this method is that it also enhances the noises in the input image along with the image features. To get rid of the high computational cost, another approach is to apply non-overlapping block based HE. Nonetheless, most of the time, these methods produce an undesirable checkerboard effects on enhanced images.[1]

GHE takes the global information into account and cannot adapt to local light condition. Local Histogram Equalization (LHE) performs block-overlapped histogram equalization , [5]. LHE defines a sub-block and retrieves its histogram information. Then, histogram equalization is applied for the center pixel using the CDF of that sub-block. Next, the sub-block is moved by one pixel and sub-block histogram equalization is repeated until the end of the input image is reached. Though LHE cannot adapt to partial light information [7], still it over-enhances some portions depending on its mask size. Actually, using a perfect block size that enhances all part of an image is not an easy and smooth task to perform.

VII. Conclusion

Histogram object to accumulate the histogram information, you generate the histogram for an image with the histogram operation. The histogram operation scans a specified region of an image and generates a histogram based on the pixel values within that region of the image. The region of interest does not have to be a rectangle. If no region is specified (null), the entire image is scanned to generate the histogram. The image data passes through the operation unchanged.

References

[1] R. Gonzalez and R. Woods Digital Image Processing, Addison-Wesley Publishing Company, 1992.

[2] A. Torre, A. M. Peinado, J. C. Segura, J. L. Perez-Cordoba, M. C. Benitez, and A. J.Rubio, "Histogram equalization of speech representation for robust speech recognition," IEEE Trans. Speech Audio Processing, Vol. 13, pp. 355–366, 2005.

[3] A. Wahab, S. H. Chin, and E. C. Tan, "Novel approach to automated fingerprint recognition," IEEE Proceedings Vision, Image and Signal Processing, Vol. 145, pp. 160–166, 1998.

[4] S. D. Chen, and A. R. Ramli, "Minimum mean brightness error bihistogram equalization in contrast enhancement," IEEE Trans. Consumer Electron.,Vol. 49, No. 4, pp.1310–1319, 2003.

[5] V. Caselles, J. L. Lisani, J. M. Morel, and G. Sapiro, "Shape preserving local contrast enhancement," in Proc. Int. Conf. Image Processing, pp. 314–317, 1997

[6] Y. T. Kim, "Contrast enhancement using brightness preserving bihistogram equalization," IEEE Trans. Consumer Electron., Vol. 43, No. 1, pp. 1–8, 1997.

[7] C. C. Sun, S.-J. Ruan, M.-C. Shie, and T.-W. Pai, "Dynamic contrast enhancement based on histogram specification," IEEE Transactions on Consumer Electronics,Vol. 51, No. 4, pp. 1300– 1305, 2005.