

A Review: Image enhancement approaches using Histogram Equalization

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ABSTRACT: Image enhancement is to process the image for getting more suitable result than original image for specific parameters. Many images suffer from poor contrast. Image enhancement improves an image appearance by increasing dominance of some features between different regions of image. Histogram equalization (HE) is that which is widely used for enhancing contrast in various parameters due to its simple function. In this paper various enhancement techniques in literature are discussed with their effects and methodologies.

I. INTRODUCTION:

Image enhancement is the image quality improvement in digital form. Images in computer are stored in form of pixels or in grid of element. These pixels contain image's color and brightness information. The purpose of image enhancement is to bring out the details hidden in an image or to increase contrast of image. Some form of degradation occurs at output at time of digitizing the image. The image enhancement technique is that which brings out the details that is obscured, or to highlight certain features of interest in an image. When we increase the contrast of an image and filter it to remove noise "it looks better". Enhancement of image is very subjective area of image processing. Improvement in degraded image's quality can be achieved by using enhancement technique. The process of improving the quality of digitally stored image by manipulating the image with software. Advanced photo enhancement software also support many filters for altering image in various ways. The digital image enhancement process includes the remove of artifact, color correction, filter adding and reduction.

II. HISTOGRAM EQUILIZATION: This method increases global contrast of many images, especially when the usable data of the image is represented by close contrast value. If we know the function of histogram equalization then we can recovered the original histogram by decreasing the usable signal contrast of background noise increases. It flattens and stretches the dynamic range of the image's histogram and results in an overall contrast improvement. Histogram equalization is that which can produce undesirable effects when applied to low color depth image. Histogram equalization can also be used for color image by applying the equalization separately to red, green and blue components. It tends to change the mean brightness of image to the middle level of the gray-level range. In HE, there are some gray level in the image, which occur frequently and dominate other gray level with lower frequency of occurrence. It results loss of

brightness of original image. The histogram provides a compact summarization of the distribution of data in an image. The color histogram of an image is relatively invariant with translation and rotation about the viewing axis, and varies only slowly with the angle of view. A histogram is the estimation of the probability distribution of a particular type of data. By viewing the image's histogram, we can analyze the frequency of appearance of the different gray levels. The histogram of an image represents the relative frequency of occurrence of various gray levels in an image, the histogram of two image: one colored and the other black and white. For black and white images we shall have 256 gray levels, from 0 up to 255, and the vertical lines in histogram indicate how many pixels in an image assume a particular gray level. The histogram of digital image with gray levels in the range[0,L-1] is a discrete function $p(r_k) = n_k/n$, where r_k is k th gray level, n_k is the number of pixels in the image and $k=0,1,2,\dots,L-1$. $p(r_k)$ gives an estimate of the probability of occurrence of gray level r_k . In histogram equalization technique, it is the probability density function (pdf) that is being manipulated. To make it simple, it changes the pdf of a given image into that of a uniform pdf that spreads out from the lowest pixels value(0 in this case) to the highest pixels value(L-1). this can be achieved quite easily if the pdf is a continuous function.



Fig1: an image before and after equalization [12]

III. LITERATURE REVIEW

There are several of techniques used for enhancing image.

A. Global Histogram Equalization (GHE)[1] uses the histogram information of the entire input image for its transformation function. It fails to adapt with the features of local brightness of input image.

Suppose input image $f(x, y)$ composed of discrete gray levels in the dynamic range of $[0, L-1]$. The transformation function $C(r_k)$ is defined as

$$s_k = C(r_k) = \sum_{i=0}^k P(r_i) = \sum_{i=0}^k \frac{n_i}{n} \quad (1)$$

Where $0 \leq s_k \leq 1$ and $k=0, 1, 2, 3, \dots, L-1$.

If image contains gray levels of very high frequencies, then they dominate with other gray levels having lower frequencies. In these situations, GHE remaps the gray levels in such a way that the contrast stretching becomes limited in some dominating gray levels which have larger image histogram components and causes contrast loss for small ones.

B. Local Histogram Equalization (LHE)[1] is that which can get rid of such problems. LHE defines a sub-block and retrieves its histogram information. It uses a small window that slides through every pixel of the image sequentially and only the block of those pixels falls in this window are taken into account for HE and then gray level mapping for enhancement is done only for the centre pixels of that window. LHE requires high computational cost and sometimes it causes over-enhancement in some portions of the image. It also enhances the noises in the input along with the image features. One approach is to apply non-overlapping block based HE, to get rid of high computational cost.

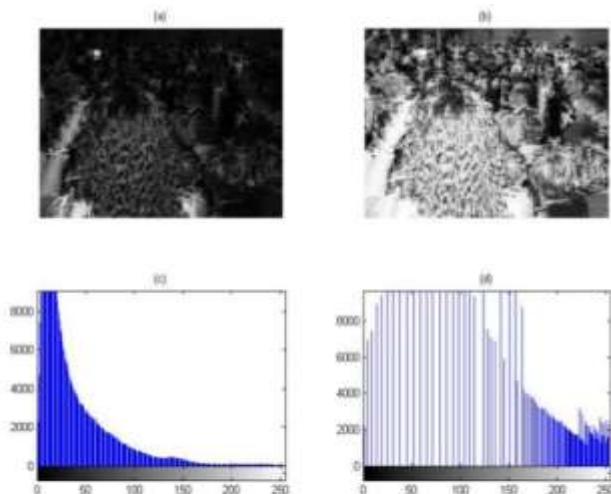


Fig2: Represents the histogram of original and equalized image [13]

Histogram equalization is one of well-known method for enhancing the contrast of given images in accordance with the sample distribution of an image[1,2]. Further many HE algorithms have been proposed till date but the initial algorithm which were introduce had some drawback that the brightness of an image can be changed after the histogram

equalization due to the flattening property of the histogram equalization. **C. Bi-histogram Equalization:** A novel extension of histogram equalization, which is Mean Preserving Bi-histogram Equalization (BBHE) [2], is proposed to overcome the above problem of typical histogram equalization. The main purpose of this algorithm is to preserve the mean brightness of a given image while the contrast is enhanced. BBHE is capable for preserving the mean brightness of given image. Simulation results also demonstrate the brightness-preserving function of the BBHE while enhancing contrasts. Various applications can be made easily by utilizing the proposed algorithm in the field of consumer electronics, such as TV, camcorder. This method is the base for enhancing the brightness of image.

D. Dualistic sub-image histogram equalization The luminance of an image may be changed significantly after the equalizing process in some conditions, because of this it never be uses in video system in the past, so a updated histogram equalization technique, which is called as equal area dualistic sub-image histogram equalization (DSIHE)[3] technique has been proposed. It can resolve the above problem. The original image is decomposed into two equal area sub-image based on its gray level probability density function. Then the two sub-image are equalized respectively. At last, we get the result that sub-image are composed into one image. This algorithm can not only enhance the image visual information effectively, but also constrain the original image's average luminance from great shift. DSIHE is the updated technique to keep image luminance well enough to make it possible to be used in video system. DSIHE will change the brightness to the middle level between the median level and the middle one of the input image. In DSIHE two separate histogram are created according to the median gray intensity instead of mean[2] intensity it can maintain brightness and entropy, but DSIHE cannot adjust level of enhancement and are not robust to noise.

Histogram equalization tends to change the mean brightness of the image to the middle level of the permitted range, and hence it is not very suitable for consumer electronics products, where the original brightness preservation is essential to avoid annoying artifacts. For making the histogram as flat as possible, entropy's maximization is the essential idea of HE. The essence of proposed algorithm named

E. Brightness Preserving Histogram Equalization with Maximum Entropy (BPHEME)[4], tries to find the target histogram that maximize the entropy, under the constraints that the mean brightness is fixed then transform the original histogram to that target one using histogram specifications. BPHEME can not only enhance the image effectively, but also preserve the original brightness quite well.

IV. CONCLUSION

After analyzing the techniques of image enhancement it is analyzed that in initial the GHE, LHE methodologies were proposed out of which the LHE results are much better later on as brightness preserving was the major objective of researchers they worked on a technique name BBHE. Further enhancements were basically on BBHE to enhance it as DSIHE, BPHEME etc their main focus was to enhance the BBHE along with some addition to them as DSIHE did divide the image into sub section rest scenario for enhancement was

same as BBHE, so it is concluded that BBHE is base technique of all recent equalization algorithms if further enhancements are to be done that can be done by combining BBHE with an approach which will give better results .

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Author Profile



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