ISSN 2250-3153

Histogram Equalization by Cumulative Frequency Distribution

Papiya Chakraborty

Asst. professor, IT Dept, Calcutta Institute of Technology, Uluberia, Howrah, India

Abstract- Image enhancement is one of the most important issues in image processing. Various enhancement schemes are used for enhancing an image which includes gray scale manipulation, filtering and Histogram Equalization (HE). In This Paper I use a new method for image quality Enhancement by Histogram equalization. It will become a popular technique for contrast enhancement because this method is simple and effective. To perform histogram equalization of an image, we have to derive the cumulative density function and intensity mapping that will as best as possible of each pixel to equalize the image histogram. For each intensity in the original image, an intensity is calculated for the transformed image that has as close as possible, the same amount of Cumulative frequency.

Index Terms- Histogram Equalization, Cumulative density function, Intensity mapping, contrast enhancement.

I. INTRODUCTION

In general literature survey **[1-7]** we came to know that a histogram is the estimation of the probability distribution of a particular type of data. An image histogram is a type of histogram which offers a graphical representation of the tonal distribution of the gray values in a digital image. By viewing the image's histogram, we can analyze the frequency of appearance of the different gray levels contained in the image. If there are 256 gray levels and the image only has values between approximately 50– 100. Therefore this image has low contrast.

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 **[5], [7], [8], [9].** Different methods have already been developed for this purpose **[3],[4], [6], [11],[12].** Some of these methods make use of simple linear/nonlinear gray level transformation functions **[6]** while some of the others use complex analysis of different image features**.[12]**

The main purpose of image enhancement is to bring out detail that is hidden in an image or to increase contrast in a low contrast image. Whenever an image is converted from one form to other such as digitizing the image some form of degradation occurs at output. Comparative analysis of different enhancement techniques will not be carried out here. An original image is normalized and the range of its intensities is [0, to 7], and F(x) is the density function of intensity distribution of the original image, where F(I) denotes the intensity value of the normalized image .and CuF denotes the cumulative density function of each pixel. The desired density function of intensity distribution of the output image is equal to 1 after equalization

II. SOME EXISTING METHOD OF HISTOGRAM EQUALIZATION

A. Adaptive Histogram Equalization method:

The major objective of the Adaptive histogram Equalization method **[11]** is twofold; locally adaptive histogram equalization and reduction of undesired artifacts such as noise and blocking artifact. Move specifically, local adaptivity is incorporated by block-based processing, blocking artifact is reduced by overlapping adjacent blocks, and noise is suppressed by spatio-temporally adaptive filtering. The detail of block-overlapped histogram equalization algorithm is summarized as following without considering image boundary.

B. Recursive mean square histogram equalization method :

In this paper**[4],** a new contrast enhancement algorithm referred as the Recursive Mean-Separate Histogram Equalization (RMSHE**)** with scalable brightness preservation is proposed. The main idea lies on recursively separating the input histogram based on the mean.

The ultimate goal behind the RMSHE is to allows higher level of brightness preservation to avoid unpleasant artifacts and unnatural enhancement due to excessive equalization while enhancing the contrast of a given image as much as possible.

C. Global Histogram equalization method

Some enhancement algorithms have been developed for yielding better visual contrast such as global histogram equalization (GHE)**[1]**

For GHE, the histogram is constructed using all pixels of the image. Next, using the histogram equalization technique, the enhanced image can be obtained by the new transformation function. GHE is fast and simple but can lead to an increase in noise

III. DESCRIPTION OF ALGORITHM

1. Create the histogram for the image.

2. Take eight possible gray scale level, i.e 0 to 7

3. Calculate the cumulative frequency distribution function

4. Maximum intensity value is divided into equal pixel value and only integer value is taken.

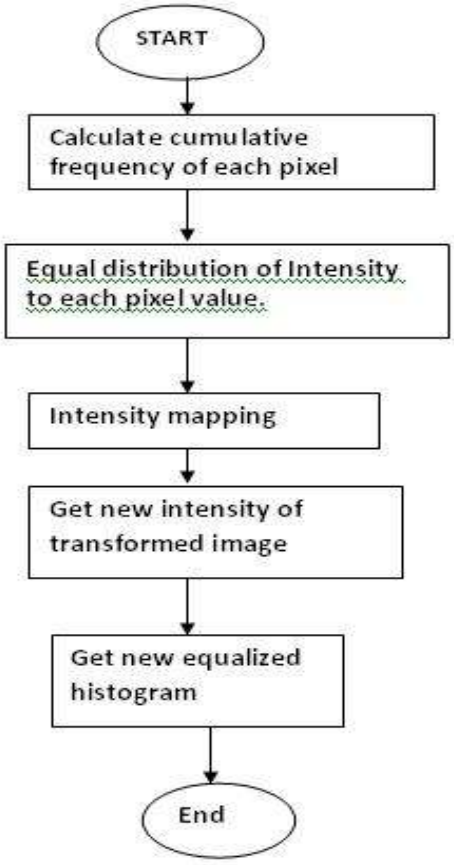
5. Assign new values for each gray value in the image.

6. Compare with the cumulative frequency of an equalized histogram.

7. Find intensity in the transformed image, that has close as possible the same amount of cumulative frequency.

8. Design the mapping

IV. THE BLOCK DIAGRAM FOR ALGORITHM IMPLEMENTATION



V. PROPOSED APPROACH FOR GETTING EQUALISED HISTOGRAM

Given an image as below, derive the intensity mapping that will as best as possible equalize the image histogram. The image histogram is as shown on the right. There are 8 possible grey scale levels from 0 to 7.

6	6	6	6	6
5	6	4	6	5
5	4	4	4	5
5	6	4	6	5
6	6	6	6	6

I	0	1	2	3	4	5	6	7
f(I)	0	0	0	0	5	6	14	0

calculate the cumulative frequency distribution (Cuf).

I	0	1	2	3	4	5	6	7
f(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25

Idea is to derive an intensity mapping that will make the CuF turn into a straight slope

Compare with the CuF of an equalized histogram

In this case the Equalized (ideal) histogram needs to have 25/8 pels in each bin = 3.125 but only integer numbers of pels are possible (its frequency after all). So I've added in one to make it ok

I	0	1	2	3	4	5	6	7
F(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25
Feq	3	3	3	3	3	4	3	3

Design the mapping

I	0	1	2	3	4	5	6	7
F(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25
Feq	3	3	3	3	3	4	3	3
CuFeq	3	6	9	12	15	19	22	25

For each intensity in the original image, find an intensity in the transformed image that has as close as possible, the same amount of Cumulative frequency

So for intensity 0, this has Cuf 0, and 0 is close to 3. CuFeq 3 generated for I=0.So Intensity 0 in the input image maps to intensity 0 in output image.

I	0	1	2	3	4	5	6	7
F(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25
Feq	3	3	3	3	3	4	3	3
CuFeq	3	6	9	12	15	19	22	25

Intensity 1 in input maps to Intensity 0 in output Same Intensity 2 and 3 in input maps Intensity 0 in output

I	0	1	2	3	4	5	6	7
F(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25
Feq	3	3	3	3	3	4	3	3
CuFeq	3	6	9	12	15	19	22	25

But intensity 4 maps Cuf value 5 and 5 is the closest of CuFeq Value 6 which maps the intensity value 1. So input 4 maps 1 in output.

Input I	Output I
0	**0**
1	**0**
2	**0**
3	**0**
4	**1**

4 -> 1

Intensity 5 maps Cuf value 11. Which is close to CuFeq Value 12.which maps the intensity 3. So for input image 5 output image pixel value will be 3.

I	0	1	2	3	4	5	6	7
F(I)	0	0	0	0	5	6	14	0
Cuf	0	0	0	0	5	11	25	25
Feq	3	3	3	3	3	4	3	3
CuFeq	3	6	9	12	15	19	22	25

Input I	Output I
0	**0**
1	**0**
2	**0**
3	**0**
4	**1**
5	**3**
6	**7**
7	**7**

5 -> 3
6 -> 7
7 -> 7

And so on …The new equalized histogram result is shown in the next part.

VI. THE EXPERIMENT AND RESULT

6	6	6	6	6
5	6	4	6	5
5	4	4	4	5
5	6	4	6	5
6	6	6	6	6

Original

Input I	Output I
0	0
1	0
2	0
3	0
4	1
5	3
6	7
7	7

7	7	7	7	7
3	7	1	7	3
3	1	1	1	3
3	7	1	7	3
7	7	7	7	7

Equalized

VII. CONCLUSION

The Proposed algorithm has been implemented using Cumulative frequency distribution without help of any probability density function. In order to evaluate the proposed method previous some method result are compared with this new approach. GHE[1] is fast and simple but cannot lead to an increase in noise. Resulting image is getting poor as inner region was darker and outer region was brighter. In Adaptive histogram[11] method over equalization is not prevented perfectly. In RMSHE method[4] blocking effect appears. The proposed method can prevent over equalization and remove noise. Contrast is enhanced 72% compared to other method and intensity become lower.

VIII. FUTURE ENHANCEMENT

This histogram equalization algorithm is executing for gray image basically. In future, for the enhancement purpose color images can be taken from the different application fields so that it becomes clearer that for which application which particular technique is better both for Gray Scale Images and color Images. Particularly, for color images there are not many performances measurement parameter considered. So, new parameters can be considered for the evaluation of enhancement techniques. New color models can also be chosen for better comparison purpose. Optimization of various enhancement techniques can be done to reduce computational complexity as much as possible.

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AUTHORS

First Author –Papiya Chakraborty, Asst. professor, IT Dept, Calcutta Institute of Technology, Uluberia, Howrah, Email: Papiya.bhowmick@gmail.com