Image Analysis, Brightness Improvement and Enhancement of Image using Histogram Equalization Technique

Miss. Priyanka Hajare
CSE and Amravati University
priyanka1hajare@gmail.com

Akshay .P Rahane
CSE and Amravati University
akshayrahane420@gmail.com

Vikrant V. Sangekar
CSE and Amravati University
vsangekar@gmail.com

Abstract:- The histogram Equalization is simple Brightness improvement technique. Simplification is the key factor of the Histogram Equalization. This paper represent the how brightness will improve using the function which are given in the paper. The paper proposes the function which is Probability density function and Cumulative distributive function these function can help to show the grey level image and Brightness Improvement in output image.

Keywords:-*Image analysis, Normalization and Image Enhancement Algorithm.*

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I. Introduction

Contrast enhancement techniques are used widely in image processing. One of the most popular automatic procedures is histogram equalization. Digital image processing is being used in many domains today. In image enhancement, for example, a variety of methods now exist for removing image degradations and emphasizing important image information, and in computer graphics, digital images can be generated, modified, and combined for a wide variety of visual effects. In data compression, images may be efficiently stored and transmitted if translated into a compact digital code.

The histogram of the discrete gray-level image represents the frequency of occurrence of all gray-levels in the image. Histogram equalization well distributes the pixels intensity over the full intensity range.

II. Image Analysis

The Analysis of Image is to study the pixel values and grayscale values from the selected image. Histogram equalization usually increases the global contrast of the processing image. This method is useful for the images which are bright or dark.8 bit grayscale image there are 256 different possible intensities so the histogram will graphically display 256 numbers showing the distribution of pixels amongst those grayscale value.

For a given image X, the probability density function P(X_k) is defined as,

$$\boldsymbol{P(X_k) = \frac{N_k}{k}} \quad ----------(1)$$

Where, (0≤ K ≤ L-1)

For k = 0, 1… L – 1, where represents the number of times that the level (X_k appears in the input image X and n is the total number of samples in the input image. Note that P (X_k) is associated with the histogram of the input image which represents the number of pixels that have a specific intensity. In fact, a plot of N_k vs. X_k is known histogram of X.

$\boldsymbol{P(X_k)}$is tells us that what is the probability of occurance of a pixels having intensity value equal toX(k).**L** is the total number of gray levels in the image, **N** is the Total number of pixels in the image**,** $\boldsymbol{N_k}$is the total number of pixels with the same intensity level.

Consider the discrete grayscale input Image X=x(i,j) with the L discrete levels, where x(i,j) represents the intensity levels of the image at the spatial domain (i,j) .

Based on the probability density function, the cumulative density function is defined as,

CDF $(\boldsymbol{x_i})$=$\sum_{i=0}^{k} P(\boldsymbol{x_i})$ ---------- (2)

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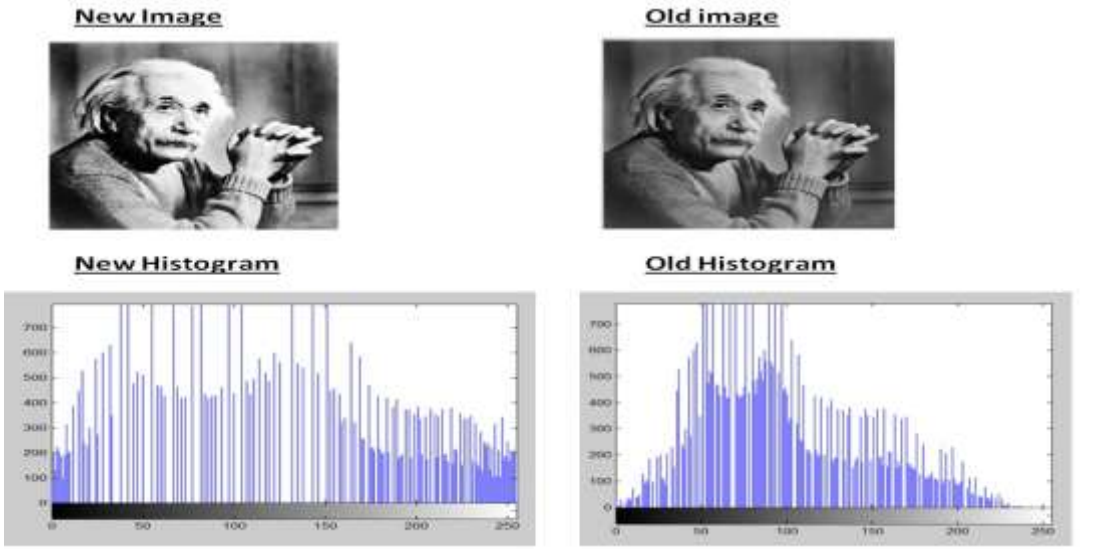
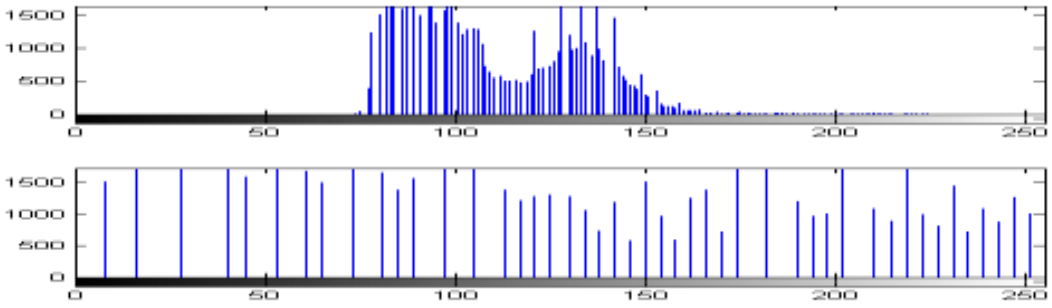
From equation (1) and (2) we get below output, Below 2 images tells that using old image we can find new uniform image or enhanced image.



III. Normalization

Normalization is nothing but the just normalized the all pixel values in the whole number 0 and 1.Using the above formulas and function we can find out the whole number that is explain and given below :



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Fig(2):show the Gray scale image and Normalized histogram

Above fig (2) represent the gray level of image we normalized this values in [0,1] where 0 indicate Black pixels and 1- indicate the white pixels. Using probability density function and cumulative distributive function we can find the whole number.

Gray level	N(k)	PDF	CDF	(L-1)*CDF	Round off
0	790	0.19	0.19	1.33	1
1	1023	0.25	0.44	3.08	3
2	850	0.21	0.65	4.55	5
3	656	0.16	0.81	5.67	6
4	329	0.08	0.89	6.23	6
5	245	0.06	0.95	6.65	7
6	122	0.03	0.98	6.86	7
7	81	0.02	1.00	7.00	7

Table: shows all values.

Let us take a another example to understand this ,

First of all take the gray scale image in the matrix form

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3	2	4	5
7	7	8	2
3	1	2	3
5	4	6	7

Fig show the 4×4 matrix example

Let each element be a pixel of an image and the values of element represent the intensities of the pixels. We can see that the intensities of the pixels vary between 1-8.suppose that we want to perform histogram equalization on this image and scale the intensity 1-20.

First step:- Is to count the total number of pixels associated with each pixels intensity.

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No of pixels	1	3	3	2	2	1	3	1	0	0

Second step:- Is to calculate probability of each pixel intensity in the image matrix.

Total number of element 16. Probability is the number of pixels divided by number of pixels (16).

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No of pixels	1	3	3	2	2	1	3	1	0	0
Probability	0.625	0.1875	0.1875	0.125	0.125	0.625	0.1875	0.625	0	0

Third step: Calculate the cumulative probability.

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No .of Pixels	1	3	3	2	2	1	3	1	0	0
Probability	0.625	0.1875	0.1875	0.125	0.125	0.625	0.1875	0.625	0	0
Cumulative probability	0.625	0.25	0.4375	0.5625	0.6875	0.75	0.9375	1	1	1

Fourth step:- Since we want to change the intensity range 1-20, we shall multiply cumulative probability by 20.

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No of Pixels	1	3	3	2	2	1	3	1	0	0
Probability	0.625	0.1875	0.1875	0.125	0.125	0.625	0.1875	0.625	0	0
Cumulative Probability	0.625	0.25	0.4375	0.5625	0.6875	0.75	0.9375	1	1	1
C.P *20	1.25	5	8.75	11.25	13.75	15	18.75	20	20	20

Fifth step:- Finally we round the decimal values obtained to the lower integer values(also known as floor rounding like, Example:-13.15=13.00.

So the original image has been transformed to the equalized image with the different intensity

On each pixels.

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No of Pixels	1	3	3	2	2	1	3	1	0	0
Probability	0.625	0.1875	0.1875	0.125	0.125	0.625	0.1875	0.625	0	0
Cumulative Probability	0.625	0.25	0.4375	0.5625	0.6875	0.75	0.9375	1	1	1
C.P *20	1.25	5	8.75	11.25	13.75	15	18.75	20	20	20
Rounding value	1	5	8	11	13	15	18	20	20	20

Now we get the final result,

8	5	11	13
18	18	20	5
8	1	5	8
13	11	15	18

Fig show the 4×4 matrix result of above input image (4×4 matrix)

We can see that the intensity range of the pixels have been increased and hence the histogram of the image will more spread .this in turns is called as Histogram equalization.

IV. Image Enhancement Algorithm and Brightness Improvement Algorithm

The below Algorithm is to take the input from the selected image Using the various function which probability density function this function is to find the pixel probability and another function is Cumulative distributive function which convert the image in uniform pixels values or distribute the pixels almost equally that gives the output image.

Step 1: START
Step 2: First is to analyze the image using Probability density function (PDF) or take the all pixel values using PDF.
Step 3: Then normalized this pixel using Cumulative Distributive function means distribute the pixel values or normalized pixel values which are took from the PDF.
Step 4: Then Round off the all the pixels values which are took from the Cumulative Distributive function.
Step 5: Then this pixels means whole number are Enhanced the Image and show the output Image.
Step 6: STOP

V. Conclusion

This paper is gives the Entire information on Histogram Equalization. The procedure Histogram Equalization is given in this paper first step is to analyze the image get the all the pixel values of image and next step is to normalize and Equalized the Histogram of both the input and output images using the Probability density function and Cumulative distributive Function. The Java Libraries are supportable to the Histogram Equalization so I implement the front end of Histogram Equalization in HTML 5 and Back end in Java.

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