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IMPROVEMENT OF DIGITAL IMAGE WITH HISTOGRAM EQUALIZATION METHOD

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Abstract

Digital image has become an inherent thing in everyday life. This is supported by the increasingly sophisticated technology of today where communication devices such as mobile phones have been able to use the role of replacing analog cameras to take pictures or even record videos. Capture the moments of happiness or just want to record an event becomes very easy to do, but sometimes the resulting photo is less satisfactory because of the mobile phone's specifications and other factors such as poor lighting (dark). Efforts to improve become very necessary, but because the application to do this only exists on the computer and not too many are found on mobile phones, this becomes difficult to do. One method for image enhancement is the Histogram Equalization method. This method can be used to improve image quality related to lighting by maintaining color constancy. The use of the histogram equalization method is considered easy because of its simplicity and relatively better performance on almost all types of images. The operation of HE (Histogram Equalization) is carried out by remapping the gray level of the image based on the probability distribution of the gray input level. This flattens and dynamically stretches the various histogram images and results in an overall increase in contrast.

Keywords: image, improvement, equalization

1. Introduction

In image management, there are many methods for image improvement that are closely related to digital image improvement. One method for image enhancement is the Histogram Equalization method. Where is this method that the author will use in editing this video because the method is relatively simple and easy to apply to an image improvement program? This method can be used to improve image quality related to lighting by maintaining color constancy.

Color constancy is one of the features of the human vision system, which strives for the colors received from an object to look the same even though they are in different lighting conditions. For example, an apple will look green during the daytime with the main lighting being the white of the sun. The apple will also look green at sunset or with red lighting. This is what helps humans to identify an object. The use of the histogram equalization method is considered easy because of its simplicity and relatively better performance on almost all types of images. The operation of HE (Histogram Equalization) is carried out by remapping the gray level of the image based on the probability distribution of the gray input level. This flattens and dynamically stretches various image histograms and results in an overall increase in contrast.

Image sharpening aims to enhance images from a human visual perspective. Image features such as edges, borders, and sharp contrast in a way that their dynamic range increases without any change in the content of information inherent in the data. For this purpose, several techniques have been developed. These include contrast manipulation, noise reduction, crispening and sharpening edges, filtering, pseudo coloring, image interpolation and magnification.

2. Literature riview

2.1 Definition of Digital Imagery

Image is a representation (picture), similarity, or imitation of an object. The image is divided into two, there is an analog image and a digital image. Analog images are continuous images such as images on television monitors, X-rays, CT Scan results, etc. Whereas digital images are images that can be processed by computers. A digital image can be represented by a matrix consisting of M columns N rows, where the intersection between columns and rows is called pixels (pixels = picture element), which is the smallest element of an image. Pixels have two parameters, namely coordinates and intensity or color. The value contained in the coordinates (x, y) is f (x, y), which is the intensity or color of the pixel at that point. [1] - [5]

Digital image processing is a scientific discipline that studies matters relating to image quality improvement (contrast enhancement, color transformation, image restoration), image transformation (rotation, translation, scale, geometric transformation), selection of feature images (feature images) optimal for analysis, carry out the process of drawing information or description of objects or the introduction of objects contained in the image, perform data compression or reduction for data storage, data transmission, and data processing time. The input of image processing in the image, while the output is the processed image

2.2 Histogram Equalization Method

Image repair is one of the simplest and most interesting methods in digital image processing (journal method of histogram equalization for digital image improvement). The idea behind image improvement techniques is to bring out obscured details, or just to highlight certain interesting features in an image. It is important to remember that enhancement is a very subjective area of image processing. Improved image quality can be degraded achieved by using the application of image improvement techniques. [6] - [10]

Histogram equalization is a popular feature compensation technique that has been well researched and practiced in the field of image processing for the normalization of digital visual features of images, such as brightness, gray-level scale, contrast, and so on. It has also been introduced to the field of speech processing for the normalization of speech features for strong ASRs, and good approaches have been continuously proposed and reported in the literature [Dharanipragada and Padmanabhan 2000; Molau et al. 2003; Torre et al. 2005; Hilger and Ney 2006; Lin et al. 2006]. The image histogram shows the histogram of the pixel intensity values. The histogram displays the number of pixels in an image grouped by different levels of pixel intensity. In the 8-bit grayscale image, there are 256 levels of different intensity values so the histogram will be displayed graphically the distribution of each of the 256 pixel value levels.

Contrast imagery is determined by dynamic range, which is defined as the ratio between the lightest and darkest parts of pixel intensity. The histogram provides information for the contrast and overall intensity of the distribution of an image. Suppose the input image f (x, y) consists of a discrete gray level in the dynamic range [0, L-1] then the transformation function C (RK) can be defined as Equation 1:

$$S_k = T(r_k) = (L-1)\sum_{j=0}^{k} p_r(r_j) = \frac{L-1}{MN}\sum_{j=0}^{k} n_j \quad k=0,1,2,....L-1 \qquad (2.1)$$

For the transformation equation histogram equalization on digital images, the MxN variable shows the total number of pixels, L number of gray levels, and () r j p r number of pixels in the input image with the intensity value RJ. The range of gray input and output values is in the range of 0,1,2, ..., L-1. Then, histogram transformation equalization maps the input value k r (where k = 0,1,2, ..., L-1) to the output value k S.

3. Results and Discussion

Each image is a collection of dots or a combination of dots, also called pixels. An integer value between 0-255 stored in an array where the values depend on the color of the image gray level. Consists of N rows and M columns called image resolution where the units are PPI (pixels per inch) or lines per inch. Example: Given an image with a resolution of 1024x268, how many pixels are there? Then 1028 * 268 / 1M = 0.78 MP. Suppose a digital image has a gray degree L (for example an image with an 8-bit gray degree quantization, a gray degree value of 0-255) can be mathematically calculated using the formula:

$H_i = n_i \qquad i = 0,1,..., L = 1$..(3.1)
n

Where :
L = degree of gray
ni = number of pixels that have gray degrees i
n = total number of pixels in the image
Pixels in images are written with the function (x, y), where (x, y) is the level of intensity in the pixel. Written with the matrix:

(0,0) f(0,1)......................f(0,M-1)
f(1,0) f(1,1).......................f(1,M-1)
f(x,y)= f(2,0) f(2,1).....................f(2,M-1)
f(N-1,0) f(N-1,1)..........f(N-1,M-1)

As an example of table 1 it is known that the input image of the array from the initial image we take measures 8x8 pixels 85 degrees gray with a range of values (0, 7):

Table . 8x8 array image

82	82	82	82	82	82	82	82
85	85	85	85	85	85	85	85
69	69	69	69	69	69	69	69
72	72	72	72	72	72	72	72
48	48	48	48	48	48	48	48
59	59	59	59	59	59	59	59
63	63	63	63	63	63	63	63
74	74	74	74	74	74	74	74

In table 1. we can see a picture with values L = 74 and n = 175x144 = 25200. So we use the equation:

$S_k = T(r_k) = (L-1)\sum_{j=0}^{k} p_r(r_j) = \frac{L-1}{MN} \sum_{j=0}^{k} n_j$ ....(3.2)

k = 0, 1, 2, ..., L-1
where

$$S_k = \frac{85}{64} \sum_{j=0}^{k} n_{rj}$$

Then the following results are obtained:

Table 2 Calculation of image histograms

i/r_k	n_i/n_{rj}	$H_i = n_i/n$	$\sum_{j=0}^{k} n_{rj}$	S_k
48	8	075	8	64
59	8	0921875	16	78
63	8	0984375	32	84
69	8	1078125	38	92

72	8	1125	46	96
74	8	115625	54	98
82	8	128125	62	109
85	8	1328125	70	113

The following is a mathematical calculation:

For gray degree 48:

$$S_k = \frac{85}{64} \sum_{j=0}^{k} n_{rj}$$

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 48$$

$$S_k = \frac{85}{64} .48$$

S_k = 1.328125 x 48

S_k = 63.75 = 64

For gray degrees 59:

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 59$$

S_k = 1.328125 x 59

S_k = 78.359375 = 78

For gray degrees 63 :

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 63$$

S_k = 1.328125 x 63

S_k = 83.671875 = 84

For gray degrees 69 :

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 69$$

S_k = 1.328125 x 69

S_k = 91.640625 = 92

For gray degrees 72 :

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 72$$

S_k = 1.328125 x 72

S_k = 95.625 = 96

For gray degrees 74 :

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 74$$

S_k = 1.328125 x 74

S_k = 98.28125 = 98

For gray degrees 82 :

$$S_k = \frac{85}{64} \sum_{j=0}^{k} 82$$

S_k = 1.328125 x 82

S_k = 108.90625 = 109

For gray degrees 85 :

$S_k = \frac{85}{64} \sum_{j=0}^{k} 85$

$S_k = 1.328125 \times 85$

$S_k = 112.890625 = 113$

Then, the output of the image is as follows:

Table 3. Output 8x8 array image output

109	109	109	109	109	109	109	109
113	113	113	113	113	113	113	113
92	92	92	92	92	92	92	92
96	96	96	96	96	96	96	96
64	64	64	64	64	64	64	64
78	78	78	78	78	78	78	78
84	84	84	84	84	84	84	84
98	98	98	98	98	98	98	98

From the results of the above output, it is found that:

1. The size of the image array does not change, ie from the initial array measuring 8x8 and the output of the new array image is also 8x8. This means that the size of the image does not change.
2. The value of the output array image is higher than the initial array image, this means that the color quality has improved and there has been an improvement in the image.
3. As the image array value increases, the image file size will change, not the image format.

4. Conclusions

Applying the histogram equalization method in digital image repair can be done and is relatively easy because it only performs equalization of the histogram by calculating the values of the matrix array image with the formula of the histogram equalization method.

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