

IMPLEMENTATION OF GRAY LEVEL TRANSFORMATION METHOD FOR SHARPING 2D IMAGES

Jon hariono Sihotang

Mahasiswa Pascasarjana

STMIK Mikroskil. Jl M.H Thamrin No.140 Kel, Pusat Ps., Kec. Medan, Indonesia

Jon_hariono@gmail.com

ABSTRACT

At present image processing plays an important role, in which the processing does not only provide effects that make an image more artistic but can also improve the quality of the image itself. In the field of photography and film that is used in making animated advertisements on television, or creating effects from dangerous scenes that cannot be done by real humans. Not all digital images have a visual appearance that satisfies the human eye. Dissatisfaction can arise due to interference or lack of maximization of the image quality, such as spots appearing caused by the process of capturing imperfect images, lack of image sharpness due to uneven lighting and resulting in non-uniform intensity, image contrast is too low so objects are difficult separated from the background or interference caused by dirt that adheres to the image.

Keywords: Image, Gray Level, Sharpening

1. Introduction

Image processing is inseparable from the computer, thus spurring computer companies to improve quality in making software for image processing. At present image processing plays an important role, in which the processing does not only provide effects that make an image more artistic but can also improve the quality of the image itself. Image processing is quite widely used in daily life, for example in the medical field which is used in clarifying the results of rays (x-rays) of body organs. In the field of photography and film that is used in making animated advertisements on television, or creating effects from dangerous scenes that cannot be done by real humans. And many more fields that use image processing.

2. literature review

2.1 Digital Image

The image is a two-dimensional image produced from a continuous two-dimensional analog image into a discrete image through a sampling process. Analog images are divided into N rows and M columns so that they become discrete images. Where each pair of index rows and columns represent a point in the image. The matrix value states the value of the brightness of the point. These points are named as image elements, or pixels (picture elements). In a computer dictionary, an image or photo is termed a digital image that has a mathematical representation in the form of a matrix $C_m \times n = (CIJ)$. Gonzales and Woods (1992: 2) defines digital imagery as a function of two-dimensional light intensity $f(x, y)$ where x and y indicate spatial coordinates, and the value of f at a point (x, y) is proportional to brightness (gray level) from the imagery at that point.

2.2 Bitmap matrix

A bitmap image is an arrangement of color bits for each pixel that forms a particular pattern. These color patterns present information that can be understood following the perception of the senses of human vision. This file format is a flexible graphic format for the Windows platform so that it can be read by any graphics program. This format is capable of storing information with a level of quality from 1 bit to 24 bits. A bitmap image is defined as a function of $f(x, y)$ where x and y are the field coordinates. The magnitude f for each coordinate (x, y) is called the intensity or gray degree of the image at that point.

2.3 Definition of Gray Level Transformation

Gray Level Transformation is an image sharpening smoothing process, where the distribution of the gray degree

values of an image is made flat. To be able to do this Gray Level Transformation we need a cumulative distribution function which is the cumulative of the histogram.

A histogram is defined as the statistical probability distribution of each gray level in a digital image. Histogram Equation (HE) is a very popular technique for increasing image contrast. The basic concept of histogram equalization is to strain the histogram, so that the pixel difference becomes larger or in other words the information becomes stronger so that the eye can capture the information conveyed. [1] - [5]

2.3.1 Gray Level Transformation Graph

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 Eq

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

For the transformation equation histogram equalization on a digital image, the $M \times N$ variable shows the total number of pixels, L number of gray levels, and p number of pixels in the input image with the intensity value of RJ . The range of gray input and output values is in the range of $0, 1, 2, \dots, L-1$. Then, the histogram transformation equalization maps the input value or r_j (where $k = 0, 1, 2, \dots, L-1$) to the output value S . [6] - [9]

2.3.2 How Gray Level Transformation Works

It is a chart that displays the distribution of intensity in the index or intensity of image colors. Special functions for image histograms, i.e. $\text{imhist}()$. The Imshist function counts the number of pixels of an image for each color range (0-255). It should be noted that the Imhist function is designed to display an image histogram in grayscale format. Therefore, to be able to display an RGB histogram, it is necessary to modify the Imhist function. [10]. 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:

$$h_i = \frac{n_i}{n} \quad i = 0, 1, \dots, L-1$$

Where :

L = degree of gray

n = number of pixels that have gray degrees

n = total number of pixels in the image

It is assumed that the equalization of the histogram changes the input value of RK to SK and then changes s , the form of the equation is as follows: k becomes v_k .

$$v_k = T(s_k) = \frac{(L-1)}{n} \sum_{j=0}^k n_{rj} = s_k$$

Each pixel with r_k value is mapped to s_k value, then $n_{sk} = n_{rk}$, then the equation becomes:

$$v_k = T(s_k) = \frac{(L-1)}{n} \sum_{j=0}^k n_{rj} = s_k$$

3. Discussion

3.1 System Analysis

System analysis is the decomposition of a whole system into its component parts with a view to identifying and evaluating problems, opportunities obstacles that occur, and the needs that are expected so that improvements can be proposed improvement. The things that are analyzed at the system analysis stage are problem analysis, functional analysis, ongoing system procedures analysis, information flow analysis, coding analysis, database analysis, and non-functional requirements analysis.

3.1.1 Image Data Management Process

The data used in this study are some images for testing where the image used is a grayscale image with an image size of 256 x 256 pixels, then the image will undergo a process to get an edge and produce a new image with a size of 256 x 256 pixels which is the resulting image (Output Image). The flow process diagram of image data processing will be used in this study.To simplify the image model, the first step that is often taken in image processing is to convert color images to gray-scale images. As is known color images consist of 3 matrix layers namely R-layer, G-layer, and Bi-layer. So that to carry out further processes, keep in mind the three layers above.

If each calculation process is done using three layers, it means that the same three calculations are carried out. So the concept was changed by changing the 3 layers above into 1 gray-scale matrix layer and the result is a gray-scale image. In the explanation above, changing color images to gray-scale images is done using the average gray-scale values of each layer R, G, and B. This is not a necessity. Although the results are good enough, the use of average values is still not optimal to show gray-scale images, so sometimes it has to be changed.

3.2 Application of the Gray Level Transformation Method

Before designing the system to sharpen the 2-dimensional gray image using the grayscale transformation method, there were a number of steps taken, namely:

1. Image analysis is used for conversion, namely true color images into gray images. True Color imagery can be converted to a gray image with point operations. Simply stated, intensity can be defined as the average value of the three color element values.
2. Change the color image to a gray-scale image. As is known color images consist of 3 matrix layers namely R-layer, G-layer, and Bi-layer. So that to carry out further processes, keep in mind the three layers above.
3. Change the 3 layers above to 1 layer gray-scale matrix and the result is a gray-scale image.
4. To change the colored images that have the matrix values of each r, g, and b into grayscale images with the value s, then the conversion can be done by taking the average value of r, g, and b.

In the explanation above, changing color images to gray-scale images is done by using the average gray-scale values of each layer R, G, and B.

The steps using the Gray Level Transformation Method are:

1. Determine the sample size of the digital image that will be the object of sharpening.
2. Convert a color image to a gray color
3. Calculate the grayscale value for each color pixel of the sample digital image

3.2.1 The Process of Implementing the Gray Level Transformation Method for Sharpening

Object image Input image is an image that has a color intensity ranging from 0 as a minimum value to 255 which is the maximum value. Input image objects that have a size of 5x5 pixels are then converted into a matrix form 5x5 =

25, for each Input Image image object. To get the gray level value is the sum of R + G + B values from each pixel divided by 3. The first step taken is to determine the sample size of the digital image to be sharpened by 25 pixels. Next is the process of determining the RGB value of each pixel of the sample digital image as can be seen in Table 1.

Table 1: RGB values

Pixel	R	G	B
0	222	220	204
1	220	220	212
2	237	207	192
3	220	220	212
4	220	228	220
5	220	220	212
6	220	228	220
7	228	228	218
8	220	228	220
9	228	230	228
10	212	220	212
11	220	220	212
12	220	220	212
13	212	212	196
14	220	220	212
15	204	204	188
16	152	157	152
17	190	187	190
18	179	181	168
19	187	202	197
20	187	202	197
21	204	204	188
22	212	220	212
23	212	212	204
24	221	212	212

Based on the RGB values in the above table, the greylevel color values are calculated, the following results are obtained:

Table 2: Greylevel Values

Pixel	R	G	B	Greylevel
0	222	220	204	215
1	220	220	212	217
2	237	207	192	212
3	220	220	212	217
4	220	228	220	223
5	220	220	212	217
6	220	228	220	220
7	228	228	218	225
8	220	228	220	223
9	228	230	228	229
10	212	220	212	215
11	220	220	212	217
12	220	220	212	217
13	212	212	196	207
14	220	220	212	217
15	204	204	188	199
16	152	157	152	154
17	190	187	190	189
18	179	181	168	176
19	187	202	197	195
20	187	202	197	195
21	204	204	188	199
22	212	220	212	215
23	212	212	204	209
24	221	212	212	215

3.2.2 Convolution Process with Laplace Operators

The convolution process is a processing of the Image Image object to find the grayscale level limit of the pixels in an image. There are many approaches taken to the problem. In this study, an approach was made to detect problems with training in neural networks.

4. Conclusions

This software can already be used to sharpen images with 256 colors, grayscale and negative image modes by showing sharpening 2D images in BMP and JPEG formats and pixel structure changes before and after sharpening 2D digital images.

Reference

- [1] R. D. Kusumanto and A. N. Tomponu, "PENGOLAHAN CITRA DIGITAL UNTUK MENDETEKSI OBYEK MENGGUNAKAN PENGOLAHAN WARNA MODEL NORMALISASI RGB," 2011.
- [2] Z. A. Fikriya, M. I. Irawan, and S. Soetrisno., "Implementasi Extreme Learning Machine untuk Pengenalan

- Objek Citra Digital,” *J. Sains dan Seni ITS*, 2017.
- [3] H. Mulyawan, M. Z. H. Samsono, and Setiawardhana, “Identifikasi Dan Tracking Objek Berbasis Image Processing Secara Real Time,” *Jur. Telekomun. Politek. Elektron. Negeri Surabaya*, 2011.
- [4] S. I. Syafi’i, R. T. Wahyuningrum, and A. Muntasa, “SEGMENTASI OBYEK PADA CITRA DIGITAL MENGGUNAKAN METODE OTSU THRESHOLDING,” *J. Inform.*, 2016.
- [5] A. Solichin and A. Harjoko, “Metode Background Subtraction untuk Deteksi Obyek Pejalan Kaki pada Lingkungan Statis,” in *Seminar Nasional Teknologi Informasi 2013*, 2013.
- [6] Q. Zhu, “Pavement crack detection algorithm Based on image processing analysis,” in *Proceedings - 2016 8th International Conference on Intelligent Human-Machine Systems and Cybernetics, IHMSC 2016*, 2016.
- [7] Z. Wei, H. Lidong, W. Jun, and S. Zebin, “Entropy maximisation histogram modification scheme for image enhancement,” *IET Image Process.*, 2015.
- [8] “IMPLEMENTASI METODE SIX SIGMA MENGGUNAKAN GRAFIK PENGENDALI EWMA SEBAGAI UPAYA MEMINIMALISASI CACAT PRODUK KAIN GREI,” *J. Gaussian*, 2016.
- [9] S. A. Zholob, A. V. Makievski, R. Miller, and V. B. Fainerman, “Optimisation of calculation methods for determination of surface tensions by drop profile analysis tensiometry,” *Advances in Colloid and Interface Science*. 2007.
- [10] J. Bernsen, “DYNAMIC THRESHOLDING OF GREY-LEVEL IMAGES.,” in *Proceedings - International Conference on Pattern Recognition*, 1986.