Research and Implementation of Image Enhancement Based on Spatial Domain Method

Naichuan Zhang

Nanjing University of Technology, Nanjing, Jiangsu, 210094, China.

Abstract

Image enhancement techniques usually have two methods: the spatial domain method and the frequency domain method. The spatial domain method mainly performs direct processing on the image pixel gray value in the spatial domain. In this paper, the spatial domain method and the enhancement processing of digital image are studied. By studying the principle and implementation algorithm of histogram equalization and neighborhood averaging method, the pictures processed by these two methods are compared to study the advantages and disadvantages of these two algorithms.

Keywords

Digital image processing; Image enhancement; Spatial domain; Neighborhood average.

1. Introduction

The image will cause some degradation of the image during transmission and conversion, so it is necessary to improve the degraded image.One of the methods is to reduce the secondary information by selectively highlighting the features of interest in the image without considering the cause of the image quality degradation.This method can improve the readability of the image, and the improved image does not necessarily approach the original image, but can highlight the outline of the target, attenuate various noises, convert black and white images into color graphics, and the like.This type of method is often referred to as image enhancement technology.The main content of this paper is to focus on some basic theories of image enhancement, and use the relevant software to achieve image enhancement processing.

2. Histogram equalization

Histogram equalization is to correct the histogram of the original image to a histogram of uniformly distributed gray scales by the gradation transformation function, and then correct the original image according to the equilibrium histogram.It is based on probability theory and is implemented using gray point operations to achieve enhanced goals.Its transformation function depends on the cumulative distribution function of the image gray histogram.In a nutshell, an image of a known gray probability distribution is transformed into a new image with a uniform probability distribution.Some images have a higher frequency over the low-value grayscale interval, making the details in the darker regions of the image unclear.At this time, the grayscale range of the image can be separated, and the grayscale level with a smaller grayscale frequency can be made larger.When the histogram of the image is a uniform distribution, the information entropy of the image is the largest. At this time, the image contains the largest amount of information, and the image looks clear.

In fact, since the histogram is an approximate probability density function, it is rare to obtain a completely flat result when transforming with discrete gray levels, and the gray level is often reduced after the conversion. This phenomenon is called "Degenerate" phenomenon.This is an inevitable result of the limited gray scale of the pixel.For the above reasons, the histogram

equalization of digital images can only be approximated.Histogram equalization can greatly improve the dynamic range of image grayscale.There are two ways to reduce degeneracy: a simple method is to increase the number of bits in a pixel.The general implementation method uses the following steps:

(1) Statistical histogram of the original image;

(2) Determining the processed gray level interval according to the maximum dynamic range of the given imaging system and the gray level of the original image;

(3) Finding a new gray scale after the conversion according to the obtained step size;

(4) Replace the gray scale before processing with the new gray scale after processing

3. Neighborhood average

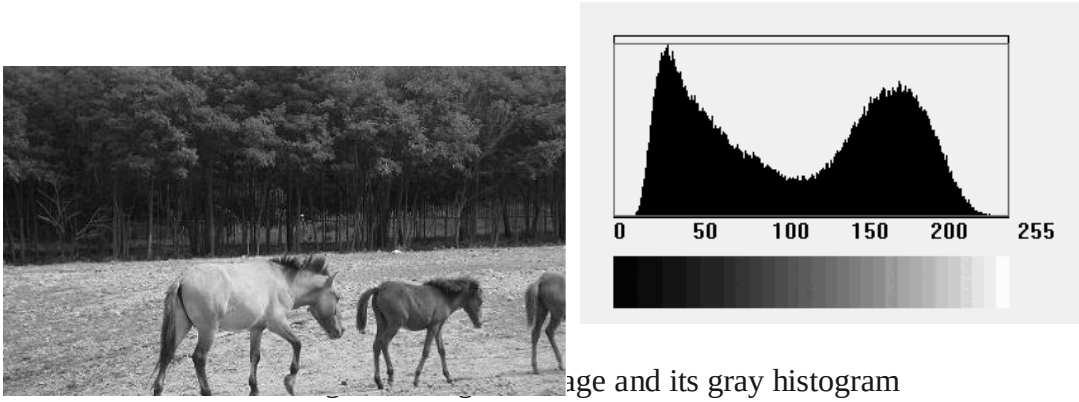
The field averaging method takes the field s for each point (m, n) in a given image f(x, y).Let s contain M pixels, and take the average value as the gray level at the image pixel point (m, n) obtained after the processing.Let S be a square neighborhood of 3*3, and point (m, n) in the center of S, then:

$$f(m,n)=\frac{1}{9}\sum_{x=-1}^{1}\sum_{y=-1}^{1}f(m+x,y+n)$$

That is to say, the result of a certain pixel is not only related to the gray level of the pixel, but also related to its neighbor point.

3 Implementation of grayscale correction

After the image is preprocessed, the image is binarized, histogram, and histogram equalized using professional software. The final result is shown in Figure 1-3.



age and its gray histogram

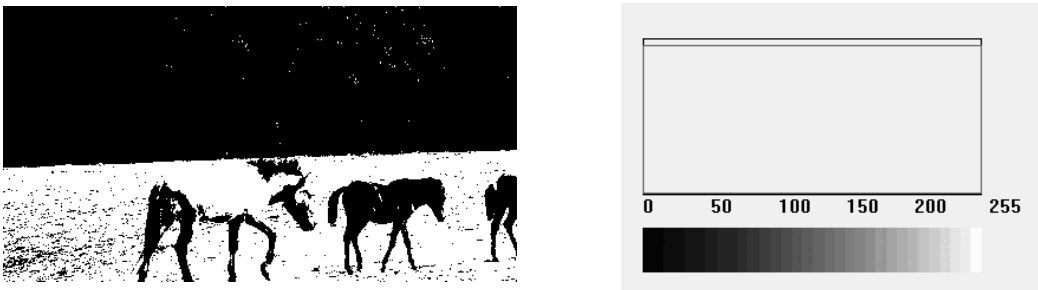


Figure 2 Binarization and its gray histogram

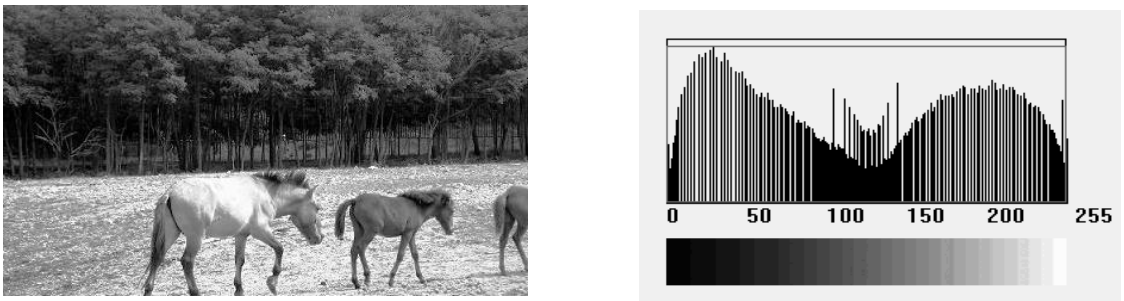
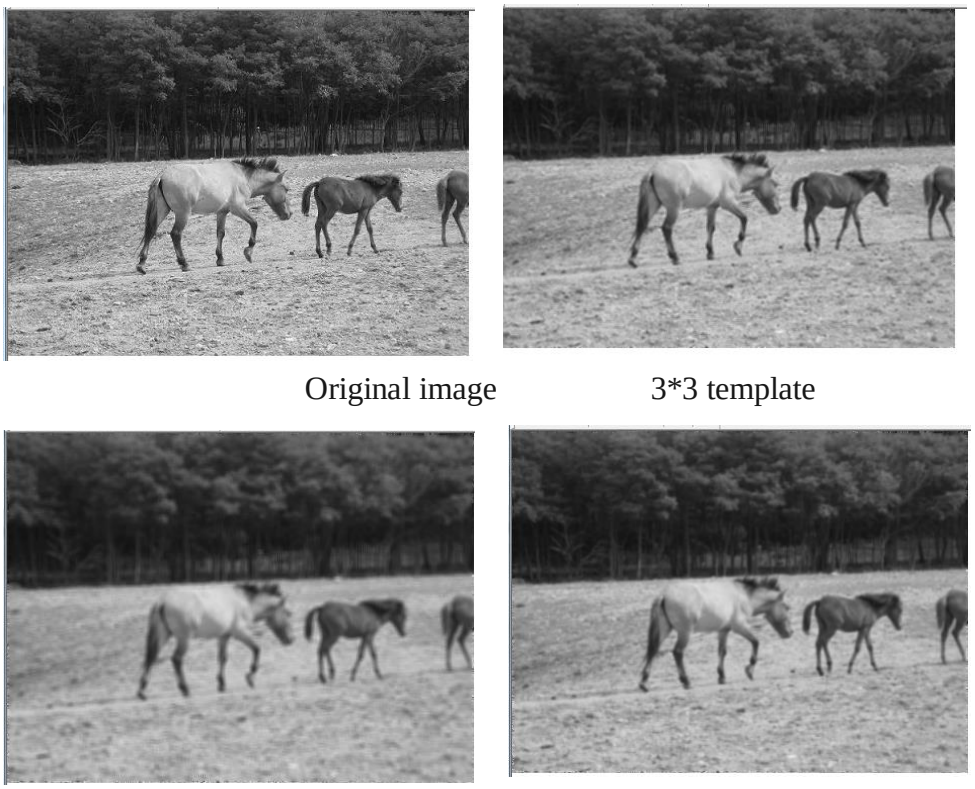


Figure 3 Histogram equalization and its histogram

It can be seen from the histogram statistics that the image is clear and dark, the contrast is large, and the image is clear and bright, which improves the visual effect of the original image.

4 Neighborhood average implementation

After the code is edited, after compiling and debugging, the program can be run to realize the average budget of the neighborhood of the image, which achieves the results shown in Figure 4.



Original image 3*3 template

Figure 4 Neighborhood average processing results

It can be seen from Fig. 4 that the idea of the neighborhood averaging method is to remove the abrupt pixel points by averaging the pixels in the neighborhood and the neighborhood, thereby filtering out certain noise. The advantage is that the algorithm is simple, the calculation speed is fast, and the cost thereof is caused. The image is blurred to some extent.

4. Conclusion

This paper mainly studies two methods that are more common in image enhancement: histogram equalization and neighborhood averaging.Among them, the neighborhood uses an average calculation method commonly used in digital image processing: template operation.By studying the principle and implementation algorithm of histogram equalization and neighborhood

averaging method, the pictures processed by these two methods are compared to study the advantages and disadvantages of these two algorithms.The application of image enhancement processing has penetrated into the fields of medical diagnosis, aerospace, military reconnaissance, fingerprint recognition, non-destructive testing, and processing of satellite images.The rapid development of image enhancement technology is inseparable from its wide application, and the driving force for development comes from the emergence of new applications.

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