

Research on several digital image processing algorithms based on photoshop plug-in architecture

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Abstract. Image technology has made great strides in the past few years, which has already taken the first place in the field of computer vision. As a very important technology, after its processing, image technology not only makes the picture more suitable for human visual perception, but also broadens the scope of the use of pictures, making it possible for pictures to be used in more areas and providing more relevant data about these areas. At present, the application of image processing has become more and more widely, involving a number of industries. This paper makes a brief introduction of digital image processing and the basic knowledge of Photoshop plug-in system, based on the Photoshop plug-in system to discuss several algorithms, and to bring forth new ideas and improvement, so as to promote the further development of image technology.

Key words. image processing, USM, canny algorithm, Gauss algorithm.

1. Introduction

Images can be seen everywhere in daily life with an important influence on people's visual perception. In many scenes of life, some things cannot be well expressed through language or other forms, but the intuitive image can better reveal the essence of these things. Therefore, image information plays an indispensable role in social life. In recent years, with the progress of science, communication technology and multimedia technology, the image processing way also has happened to go through great changes. The image processing technology can be divided into analog image processing and digital image processing, and the latter is used most widely with the highest frequency. Digital image processing is related to a lot of disciplines, such as computer science, information science, biology, etc. It is often used in industrial detection, biomedicine, etc., which plays a certain role in the development of these

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areas. While digital image processing cannot do without the basic algorithms, this paper mainly introduces and analyzes three kinds of digital image processing algorithms, namely, the USM sharpening based on Photoshop plug-in system, Canny edge detection and Gauss fuzzy. Through the experiment, these algorithms will be improved to make the image show better visual effect.

2. Digital image processing foundation

2.1. The concept and development of image processing

The image is the real object which can be seen directly by people's eyes. It is jointly presented by various observation systems, such as the human visual system, in which the image people see from the eyes is the visible thing in people's hearts. Image processing refers to the measures taken to make pictures show a predetermined result, which can be divided into analog image processing and digital image processing. Digital image processing is most widely applied in daily life and it is a technology that reconstructs the image through computer to achieve the pre-determined effect [1].

Early in the last century at the end of 70s, Marr proposed century computing theory, which laid a solid foundation for the development of computer vision. After decades of development, digital image processing technology has made great progress and has been widely used in many fields, making a significant contribution to the development of the industry [2]. In the reduction and enlargement of images, the algorithm of opportunity slice theory and the algorithm based on spline interpolation are both now commonly used methods. When the image has been reduced or enlarged, it is likely that its pixel is not quite consistent with the original image, at this time, interpolation will come in handy [3]. In the aspect of image enhancement, the related theory and method of histogram and fuzzy mathematics are now commonly used. At present, people always use the enhancement technology based on transform domain and spatial domain, and the former is mainly through the transformation of a positive intersection of the original image from the time domain to the frequency domain, and then modifies the pixel domain to enhance the image, which has more advantage than the latter. In image edge detection, canny adaptive method is one of the most commonly applied methods and theories [4]. A basic characteristic of the image is the image edge, which is the most clustered area when assessing information, and also the main substance of the analysis of the picture. Meanwhile, it is a kind of picture pretreatment method, widely used in many industries.

2.2. The features, classification and color pattern of digital images

Compared to analog image, digital image has the following three characteristics. Firstly, it has excellent flexibility, widely used in multi range. It can be seen as a set of abstract values, and is able to change these values through computers, and it can reduce or enlarge pictures, adjust the color, and erase or copy some areas of

the pictures. Secondly, it has a high degree of precision [5]. Through computer, a digital image can be infinite zoom in and out, in other words, it can be presented with a variety of pixels, and each can be divided into 4096 level gray level. Thirdly, it is easy to store and reuse. Digital images can be stored as a carrier medium to preserve the original picture, and the picture will not be changed for any reason. But analog images, regardless of how good the photographic paper and film material are, and no matter how they are kept, they will become yellow and faded with the time passed by [6].

According to its different characteristics, digital image can be divided into bit-mapped graphics and vector images. Bit-mapped images usually present an image with a lot of pixel. Each pixel has its position and color attributes, which can be subdivided into the following four types (see Figure 1). Vector images refer to the use of a pre-determined target to describe an image as a kind of drawing statement, whose essence is to express the picture constituted by geometrical factors in a mathematical way [7]. Each style in the picture represents a separate formula, which is called an object. This object is airtight, so it is easy to be found through the transformation and also its correlation with other objects. Through the formula to represent the picture, the expression of the picture through a vector image will become more vivid and delicate.

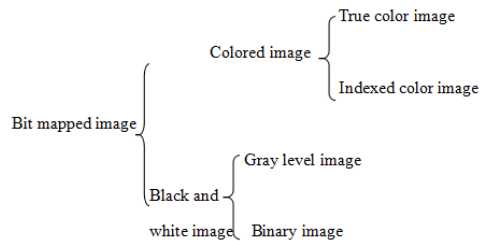


Fig. 1. bit-mapped image classification

The color pattern in the Photoshop plays a decisive role in the color model of the document. Usually there are RGB, HSB, Lab, CMYK mode and so on. The color pattern cannot only show the number of colors of pictures present, but also affects the size of the picture file and the number of channels. Photoshop menu has four options of color from conversion. First, two tone forms, whose ink in two colors when processing pictures can strengthen the total area of gray image, namely the 8-bit image with a single channel. Second, gray color form, usually appears in the form of a hub when transforming the color form, representing only the brightness and darkness of color, rather than color data, Third, RGB color form, the best choice in dealing with pictures, has more than 16,777,216 colors. However, this mode is not applied when printing pictures, because its color is sometimes too much wider than the color of the printed area. Fourth, bitmap form, which only has black and white colors, and only when the color form of the picture is consistent with the gray form, can it turn into a bitmap form [8].

3. Photoshop plug-in system

3.1. *Plug-in design based on platform*

At the time of software development, most of the staff love to operate alone, so the software styles made by different person are not the same, but these software eventually needs to be gathered together to achieve seamless connectivity. Every time in maintenance and software code gathering, the workload is so huge because of the need of re-edition and release^[9].

The huge workload in each maintenance and time aggregation needs to be re-edited and released by developers. With great efforts of developers and repeated tests, they ultimately find a solution, namely, a combination of platform and plug-ins.

Taking the computer system as an example, the real operation of computer must be based on the installation of the operating software which not only has the basic properties, but also a common interface for development personnel to use, and the relevant personnel can develop editing software through this interface, so as to make the computer system operating normally. From the user's point of view, the operating system is transparent. This is a perfect example of the combination of platform and plug-in. In addition, Photoshop software, the most widely used image processing software with powerful function, can add the function through plug-ins. Since there is a development interface in Photoshop, when software developers develop new software features, the plug-in can be installed through this interface without affecting the main program and other plug-ins^[10]. After the installation, the software can be put into use. There are three kinds of common plug-ins, namely script plug-in, text plug-in and program plug-in. In this paper, the main research object is program plug-in.

3.2. *The realization of the filter plug-in*

The first is the hardware and software configuration. The development of filter plug-in cannot do without Photoshop SDK. After downloaded from the official website, it can be installed and directly used to extract the development of Photoshop CS2 SDK applied in this article, using Visual Studio 2005 as a development tool. The second is to set up the Windows plugin. In SDK, different plugins has relatively different data organization, each with a detailed definition that can be found out from the header file. The last is the plug-in interface. Usually, if the user issues a directive, the host will automatically call the plug-in to use, and the whole process is achieved through the entry function plugin.

3.3. *The preparation of the filter plug-in*

In compiling the filter plug-in, there are several steps: `FilterSelectorParameters` call, `filterSelectorPrepare` call, `filterSelectorStart` call, `filterSelectorContinue` call, `filterSelectorFinish` call, error code and pixel location. After all the above steps are completed, the compiled 8bf file can be seen below the output path of the project,

and then copy it to the folder within the PS filter, restarting PS. Once it is loaded successfully, the filter will appear on the menu.

4. Research on several algorithms of digital image processing based on Photoshop plug-in system

In the above passage, the manufacture of filter plug-in introduced is the basis of algorithm implementation. There are three kinds of common algorithm, namely, USM sharpening, canny edge detection and Gauss algorithm.

4.1. USM sharpening algorithm

In the planning of digital printing, sharpening is very critical. The image will become vague to some extent when scanning. In addition, pictures taken by some kinds of digital cameras also need sharpening. Therefore, after treatment, the definition of those pictures should be higher than the real picture.

First, the USM algorithm principle;

The image sharpening can strengthen the appearance and lines of the scenery in a picture, so as to promote gray contrast. Locations of appearance and line are both gray chart area, so the differential action is the basis of sharpening algorithm. In the process of sharpening, there are a lot of virtual light mask providing a variety of control methods, but the premise is that the set has no error. In this paper, the USM is sharpened by the radius, the number and the threshold value, the changes of which are used to observe image processing results. The unit of the amount is percentage, which has a direct impact on the level of sharpening degree.

The radius directly influences the width of the pixel when sharpening. The larger the radius, the greater the definition of image is. There also appears halo. In the sharpness, the threshold determines the edge of the pixel gap of adjacent pixels.

The principle of USM sharpening algorithm is that Gauss radius is the very fuzzy radius. In the calculation, there appears Gauss $g(x, y)$ template, according to which, the original image can be processed by Gauss fuzzy, so as to get a new value, namely, $blur-f(x, y)$. Then calculate the value difference, namely, $different-f(x, y)$, of the color value of pixels corresponding to the initial image value and the fuzzy image. Finally, based on the threshold and numerical difference to make comparison, if the condition is not satisfied, then the value of the original picture can be replaced with a new color. Otherwise, the original value will remain the same.

Second, the improvement of the algorithm and the experimental results;

The effect of the amount, threshold and radius on the sharpening degree is observed by experiments.

(1)The impact of amount on sharpening

The threshold and radius are set to 0 and 3, and based on the changes of the amount to observe the effect of sharpening. In the experiment, the original Lcna picture is the experimental object. Figure 2 (a) represents the effect when the amount is 100%, and (b) represents the effect of 200%, (c) on behalf of 500%.

The results can be seen from Figure 2, with the increase in amount, the sharp-



Fig. 2

ening degree will be strengthened, and the contrast between black and white colors will be very distinct. When the amount increases to a certain degree, the black and white side will be very obvious and the connection between the overall shape and the image pixel will be damaged. Thus, in sharpening, the amount controls the sharpening degrees through the enlargement and reduction of edge pixel contrast.

(2) The impact of threshold on sharpening

Radius is set to 3, while the amount is still 200%, only to change the threshold, as showed in Figure 4.



Fig. 3

From Figure 3, we can clearly see that the image contrast is affected by the threshold. When the level is lower than the value set in advance, there will be no image sharpening, but if the value exceeds a certain range, no matter how the radius and amount change, sharpening will never appear.

(3) The impact of radius on sharpening

The threshold value is set to 0, and the amount is 200%, only to change the radius, as showed in Figure 4



Fig. 4

We can see that the width around the black and white edge is affected by the radius, which directly determines the pixel of sharpening.

4.2. Adaptive canny edge detection

Edge refers to the polymerization of the pixels in the outer position from two ranges. The edge of a picture contains much important data, and it is also an area where gray changes are relatively evident.

First, principle;

Early in the last century in 1980s, canny standard was proposed, that is, the standard of the edge test.

Canny edge test has the following three indexes: high positioning accuracy, high signal-noise ratio and the single edge response criterion. The main test procedure is as follows:

(1)Gauss smooth image

When using the canny algorithm to calculate, the Gauss function is set to $G(x, y)$:

$$G(x, y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right) \quad (1)$$

Gradient vector:

$$\nabla G = \begin{bmatrix} \partial G / \partial x \\ \partial G / \partial y \end{bmatrix} \quad (2)$$

(2) Calculation of the direction and amplitude of the gradient

In the past Canny algorithm, the partial derivatives $G_x [i, j]$ and G_y in the direction of (x, y) are assumed respectively as:

$$\begin{aligned} G_x [i, j] &= (I(i, j + 1) - I(i, j) + I(i + 1, j + 1) - I(i + 1, j)) / 2 \\ G_y [i, j] &= (I(i, j) - I(i + 1, j) + I(i, j + 1) - I(i + 1, j + 1)) / 2 \end{aligned} \quad (3)$$

At this time, the gradient direction and magnitude of (x, y) are:

$$\begin{aligned} G(i, j) &= \sqrt{G_x [i, j]^2 + G_y [i, j]^2} \\ \theta [i, j] &= \tan^{-1}(G_y [i, j] / G_x [i, j]) \end{aligned} \quad (4)$$

(3)Non-maximum suppression

In order to locate the edge more accurately, we use non-maxima suppression to divide the roof gradient magnitude of the G image, only to preserve a part of the maximum value. In Canny algorithm, we take (i, j) as the center, and interpolate value in the range of $3 * 3$ along the gradient. If the gradient of (i, j) is larger than the value of other directions, then this point should be the edge point; if the value is smaller, then this is not the edge point.

(4)Double threshold edge detection and connection edge

Past Canny algorithm applied double threshold detection and edge connection line. First determine the threshold of M_h and M_j in the edge point, and then scan and test the image pixels. When the pixel value is greater than M_h , then it is the edge point; when the value is between the two thresholds, then it is likely to be the edge point, and then according to their connectivity to judge; if there is no edge

point in the adjacent pixel, then this is not the edge point.

Second, the improvement of the algorithm and the experimental results;

Through experiments, it is concluded that the canny algorithm can accurately detect the edge of the image, and can find out the position of the edge points easily, which lay a good foundation for the later processing of the image. See the comparison between Figure 6 and Figure 7.



Fig. 5. original image

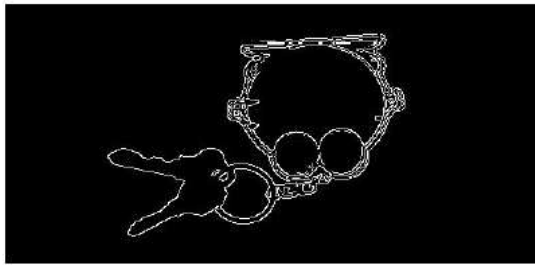


Fig. 6. the canny edge map with adaptive threshold

In this experiment, the canny algorithm is improved, and the advantages of the old algorithm are sustained, such as gradient histogram, instead of being completely abandoned. The improvement of the automation technology makes it possible that the edge can be detected through the automatically generated high or low threshold, which greatly facilitates the effectiveness and practicability of the algorithm.

4.3. Gauss algorithm

Gauss algorithm is widely used in image operation, whose main function is to reduce the detailed level of pictures and reduce picture noise. At the same time, it is often used in computer vision operation methods whose role is to enable that the effect can be strengthened by pictures in different sizes.

First, the algorithm principle;

From a mathematical point of view, Gauss fuzzy of pictures is the normal distribution as well as the convolution of them. The former is also called Gauss dispersion, which is the origin of the concept of Gauss fuzzy. Following is the function of one dimensional normal distribution:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \quad -\infty < \sigma < \infty \quad (5)$$

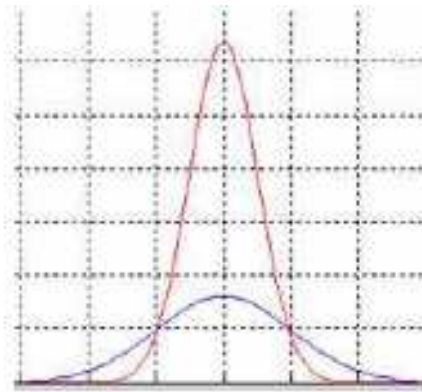
Definition of two dimensional Gauss surface function:

$$g(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{(x^2+y^2)}{2\sigma^2}}, \quad -\infty < \sigma < \infty \quad (6)$$

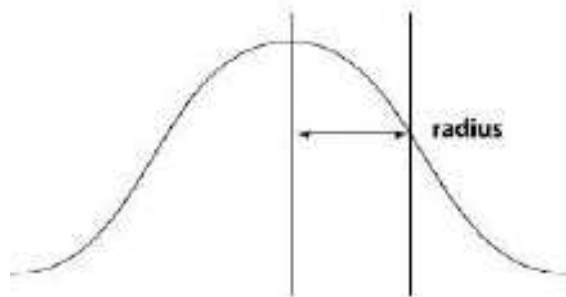
Gauss fuzzy is defined as the Gauss distribution and the convolution of the image:

$$L(x, y) = g(x, y) \times I(x, y) \quad (7)$$

$L(x, y)$ is the blurred image value, and $I(x, y)$ is the original image value. There is an independent parameter in the algorithm, namely the radius. The formula is 0 in Figure 7.



(a) Schematic of Gaussian Curve



(b) Meaning of Radius

Fig. 7. the meaning of Gauss curve diagram and radius

Through the above 7 can be seen in the shape of the curve is affected by the radius of 0, its value is greater, the curve is smooth, the smaller the value, the curve is greater. On the image, Gauss radius, the higher the value, the fuzzier picture; the smaller the value, the picture is clearer.

Second, the improvement of the algorithm and the experimental results;

(1)Improvement of algorithm

Linear separable, refers to the calculation of the two dimensional image as the above two one-dimensional spaces. The result obtained by the two dimensional matrix transformation is the same as that obtained by one dimensional matrix. According to this characteristic, the convolution of the two-dimensional Gauss distribution is divided into two steps: first, the convolution of the horizontal direction of image and its one-dimensional Gauss; second, the convolution of the image amount obtained in the first step in the vertical direction and the one-dimensional Gauss distribution. The image obtained is the result of the improved fuzzy algorithm. The image only needs to be calculated for $O(2r * M * N) + O(2r * M * N)$ times, but if you do not do them step by step, then in the calculation of $O(2r * 2r * M * N)$, r represents the template radius; while M and N represent number of dimensions. Therefore, when the value of the image needed to be processed is large, and then correspondingly, the fuzzy radius is also big. In other words, larger Gauss template can improve the efficiency of the algorithm.

At the same time, Gauss's big and small template will affect the image processing effect. In calculation, we should first determine the threshold, and only after the size of the template is set, can the threshold be set. The threshold is the template edge. In general, if Gauss blur radius is R , only the variables in $[-3R, 3R]$ are needed.

In practice, template size of $6R+1$ is used most frequently. When the Gauss template is calculated out, the amount and template convolution of image is Gauss fuzzy. And the single pixel value of pictures after the calculation is the weighted average of pixel values within the template region.

Results of experiment

The process of completing Gauss fuzzy algorithm is as follows: First, calculate the Gauss template; second, complete one-dimensional Gauss convolution in both the parallel direction and vertical direction.

Figure 8 (a) is on behalf of the original image, (b) for the imaging when the radius is 1, and (c) for the imaging when the radius is 3. Therefore, the essence of Gauss fuzzy lies in the choice of the radius.



Fig. 8

5. Conclusions

With the expansion of the scope of use, image processing technology will have better development prospects, and it has become an indispensable technology in computer vision. Image processing is to use the algorithm to process the image, which can make the processed image show a better definition, and make it more convenient for an image to express its real connotation. What's more, the processed image will be more suitable for people's visual system, providing more useful information. Image processing algorithms cannot do without the application of various algorithms. The algorithms in this thesis are all evolved on the basis of the traditional algorithms, which make image processing more efficient and convenient. But they also need to be improved continuously, in order to promote the development and progress of image technology.

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