Research on medical image processing

Wang Jinguo[1, a], Wang Na[2, b*](corresponding author),Wang Rui[3,c]

[1]Department of Urology, the First Hospital of Jilin University,China

[2]Department of Anesthesiology, the First Hospital of Jilin University, China

[3]Department of Information Engineering, Jilin Business and Technology College.

[a]wangjinguolily@163.com,[b]lilyly12345@163.com,[c]Xiaoben6666@126.com

Keywords: Image enhancement. Window Width. Window Level. Image smoothing. Image sharpening.

Abstract. In the era of information technology, the standardization and digitization of medical imaging has become an inevitable trend. Medical imaging information system has become an important tool for the analysis and processing of medical image information and the basic elements of the construction of digital hospital. Massive medical image data makes the system core component image processing module is particularly important, the research and implementation of high performance image processing module can enhance the system's image processing effect, improve the working efficiency of doctors and improve medical diagnosis level. In this paper, we study some key techniques of medical image processing, which can achieve good results.

Introduction

With the development of medical imaging technology, image processing is becoming more and more widely used in medical research and clinical medicine. The main purpose of digital image processing is to improve the image quality, so that the image is more clear, or to meet some specific requirements, but also to extract certain specific information from the image for subsequent image analysis and recognition. Digital image processing includes four aspects: improving image quality, image analysis, image reconstruction and image data compression[1]. Digital image processing technology has been widely used in medical field. At present, the image processing of CT image, endoscope image, X-ray film, microscope image and ultrasonic image has become one of the important means of medical diagnosis[2].

Medical image has very important function in the process of medical diagnosis. The doctor has a direct relationship with the understanding of the image information and the accuracy of the diagnosis. In the process of medical image acquisition and transmission, it is inevitable that the image quality can be reduced. How to restore the original image correctly is the main content of medical image processing. How to use computer graphics, statistics, mathematics morphology and so on to extract useful information from the existing image is the main content of medical image processing[3].

Image enhancement and recovery

In medical image processing, due to the limitations of some conditions, it can not identify useful information. For example, in order to improve the operating conditions of X-ray, the X-ray scanning is generally used to obtain a large number of key information in the dark area, the human eye is difficult to see. Therefore, it is necessary to improve the quality of the image by using some image

enhancement measures. The main purpose of image enhancement is two[4]: one is to improve the visual effect of the image, improve the image composition of the clarity. The other is to make the image more conducive to computer processing. From the point of image quality evaluation, the main purpose of image enhancement is to improve the image quality, even if the image is more satisfied with the observation or further processing of a certain aspect of the requirements to describe.

Window width and window position adjustment

Different organs or lesions have different CT values, so when the observation of a tissue or lesions, if the selection of the organ tissue or the lesion of the window width and window position can make the display effect to achieve the best state. At present, most of the modern CT scanner has a range from 3000 to 4000 value[5]. The computer monitor can only show 256 gray levels, the eye can only distinguish about 30 gray levels[6]. Therefore, in order to use the limited gray level to better represent the human organization of the two-dimensional distribution, the introduction of the window technology. That is, the correct choice of window width and window position value to produce images that are in line with the visual requirements, in clinical applications, the use of window technology can be very good to show the details of the doctor. We use the mouse to change the window width and window level. The horizontal left of the mouse is reduce the window width and otherwise width the window width. It can change the single DICOM image window width and window position, can also be a regulation a sequence inside all the image window width and window bit. At present, there are many kinds of the mapping relations on the window width and the window level, which are used for Linear mapping, Gamma mapping, Logarithmic mapping, and so on. Assuming that the gray value of a certain point (x,y) in the image is $f(x,y)$. MIN and MAX for the window width / window level set after the gray value and maximum value, Linear mapping relations is as shown below:

$$f'(x,y)=\frac{[f(x,y)-\min]\cdot 255}{\max-\min} \quad (1)$$

Gamma mapping relations is as shown below:

$$f'(x,y)=255\cdot[\frac{f(x,y)}{\max-\min}]^{1.0/gamma} \quad (2)$$

Logarithmic mapping relations is as shown below:

$$f'(x,y)=c\cdot\log[1+f(x,y)] \quad (3)$$

The two algorithms(2),(3) are nonlinear, and they can adjust the shape of the curve by adjusting the parameters (gamma and c). So it can achieve the purpose that compress some gray and expanse the other gray. At the same time, the nonlinear relationship can also compensate the human eye to the gray level response, with the good results. In the implementation, the gamma algorithm can easily adjust the gamma value, more easily control than the Logarithmic algorithm.

Image smoothing technique

Due to the limitations of imaging devices, the image obtained is unavoidable in the presence of noise. The purpose of image smoothing is to eliminate the noise in the image, so as to achieve the purpose of image enhancement. In the spatial domain, the smoothing algorithm of the image is generally adopted the weight neighbor average method[6].

The weight neighbor average method refers to the neighborhood of the pixels multiplied by the coefficient of the smooth, the more important pixel multiplied by the weight. For image f(x,y), if the neighborhood s is taken, the weighted average of the neighborhood is shown as following (4):

$$g(x,y)=\frac{\sum_{s=-a}^{a}\sum_{t=-b}^{b}w(s,t)f(x+s,y+t)}{\sum_{s=-a}^{a}\sum_{t=-b}^{b}w(s,t)} \qquad (4)$$

In which, $w(s,t)$ is the weight function. A commonly used weight function is a function of the distance between the points and the center point of the neighborhood. In this function, the center point has the maximum weight value, which indicates that the average value of the point is the largest. The weights of the other points in the neighborhood are inversely proportional to the distance from the point to the center point, which indicates that the contribution of each point is inversely proportional to the distance to the central point.

Image sharpening technique

The purpose of image sharpening is to blur the edges and the outline of the image, but also to make the details of the image clearer. In general, we can make use of the space of the first and two order differential operation to achieve the image sharpening.

Application of two order differential. Laplace is one of the most simple two - order differential operators with an isotropic and isotropic. For the two variable function $f(x,y)$, it is defined as follow:

$$\nabla^2 f=\frac{\partial^2 f}{\partial x^2}+\frac{\partial^2 f}{\partial y^2} \qquad (5)$$

In the processing of digital images, we need formula(5) discrete forms. We use difference operation to replace the differential operation, in the X direction and the Y direction, the difference forms of the two order differential are as follows:

$$\frac{\partial^2 f}{\partial x^2}=f(x+1,y)+f(x-1,y)-2f(x,y) \qquad (6)$$

$$\frac{\partial^2 f}{\partial y^2}=f(x,y+1)+f(x,y-1)-2f(x,y) \qquad (7)$$

After a first order or two order differential operation, the image can be obtained by the gradient image or Laplace image. They are to changes in the original image to display the content, prominent in the original image gray change faster region such as edges, details of the image more clearly.

References

[1] Goutsias J.Heijmans HJ A M.Multiresolution signal decomposition schemes, Part 1: Linear and morphological pyramids. IEEE Transactions on Image Processing . 2000.

[2] Jones Cameron L.Jelinek Herbert F.Wavelet Packet Fractal Analysis of Neuronal Morphology. Methods . 2001.

[3] Sbeh Zakaria Ben,Cohen Laurent D. Mimoun Gerard,et al.A new approach of geodesic reconstruction for drusen segmentation in eye fundus images. IEEE Transactions on Medical Imaging . 2001.
[4] Huang HK.Some historical remarks on picture archiving and communication systems , Comput Med Imaging Graph , 2003 , 27(2-3):93-99.
[5] Mildenberger P, Eichelberg M, Martin E. Introduction to the DICOM standard[J]. European radiology, 2002, 12(4): 920-927.
[6] James S Duncan, Nicholas Ayache, Medical Image Analysis: Progress over Two Decades and the Challenges Ahead, IEEE Transactions on Pattern Analysis and Machine Intelligence, 2000, 22(1): 85~105.