

Study on Medical Image Processing Technologies Based on DICOM

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Abstract—DICOM is an international standard for the storage and transmission of medical image. With the popularity of pictorial and computerized medical equipments and the development of hospital management information system, the standard is widely used. The technologies of medical image display and processing based on DICOM standard are studied. On the basis of analyzing the DICOM standards and file formats, the general idea of converting between the DICOM format and BMP format is brought forward, and the medical images can be displayed in the windows platform. The grayscale processing technologies of medical image are focused on and implemented by programming. The main methods of edge detection are discussed and the implementation steps are given. The software of DICOM medical image processing is realized by Visual C++ which can convert the medical images to BMP formats and display these medical images. The grayscale processing, anti-color, strength testing and other basic functions of medial images can be come true. It can provide convenience for medical diagnostics.

Index Terms—DICOM, Medical image, Image Processing, Grayscale processing, Edge detection

I. INTRODUCTION

With the improvement of medical devices level, most hospitals have been already equipped with a variety of digital imaging equipments, and, PACS, picture archiving and transmission system, has been established. PACS is very important in modern hospital, the key technical problem needed to be solved is to unify the image data formats and data transmission standards of all various digital imaging devices. DICOM is generated for this purpose.

DICOM is the standard used for the storage and transmission of medical images which can provide the interface standards and protocols for the manufacturers and users of the medical imaging equipments[1]. With the extensive use of PACS in the hospital, the understanding of the DICOM standard has become increasingly important, and physicians make more and more needs for the post-processing of the medical images. Then, the interpretation of DICOM medical image files, the reading of medical image data, the display and processing of image processing are very important.

In this paper, display and processing of the medical image based on DICOM format are focused on, and they are realized by software programming. The system can

provide convenience and basis for medical diagnosis and remote consultation.

II. DICOM STANDARDS

DICOM is a standard name specifically for medical image storage and transmission established by American College of Radiology (ACR) and National Electrical Manufacturers Association (NEMA). After the development of many years, it has been widely accepted by medical device manufacturers and medical community and is very popular in medical equipments.

A. Target of DICOM Standard

DICOM standard target is to promote medical imaging equipment interoperate in the multi-vendor environment, which can be reflected in the following aspects specifically.

- (1) To promote network of digital imaging devices, regardless of the developers of equipment.
- (2) To help to develop and promote the PACS, and link to other medical information systems.
- (3) To establish valuable diagnostic information database, handle requests of different devices dispersed geographically[2].

B. Features of DICOM Standard

The nowadays widely used standard is DICOM 3.0, it has the following characteristics.

- (1) Be appropriate for network environment
The early DICOM versions were only used for point to point data transmission, but DICOM3.0 supports network environment based on the OSI, TCP/IP and other common industry standards, so as to create the conditions for telemedicine.
- (2) Respond to data exchange and related instructions
The older versions are confined only to data transfer, but DICOM3.0 specifies and defines the semantics of the instructions and data by using the concepts of service classes.
- (3) Define the standard level
The former DICOM can only provide the minimum requirements of the DICOM standard that the medical device should follow, and DICOM3.0 clearly describes some necessary conformance statements to achieve a particular level.
- (4) Scalability
DICOM3.0 supports the dilation of new features.

(5) Introduce the concept of generalized information object

Information objects include not only graphics and images, but also studying, reporting and other general information objects.

(6) Establish a unique method identifying a variety of information objects

It is very important to clearly define the relationship between information objects in the network environment.

C. Outline of DICOM Standard Contents

The contents of medical image communication standard are described in 15 chapters. The main contents of every chapter are as follows.

(1) Introduction and overview

It briefly introduces the scope of the DICOM standard relating, points out the background of standard drafting and its meaning and purpose, and lists the other standards which DICOM standard references.

(2) Conformance

The chapter 2 describes that DICOM standard is a multi-level specification and a professional standard that can be referred to follow. Any Implementation of the standard in engineering can be achieved in some part or all specifications in the product. The product statement must clarify the extent of compliance with the product standard. Conformance states the content requirements and general format of the product complying with the DICOM standard.

(3) Information defining object

This chapter detailedly gives the composition of information objects and concept connotation abstracted from the medical reality of the DICOM standard. It is an important part in studying the standard and in clinical diagnosis.

(4) Service specification class

In this chapter, the standard divides the communication types which may be involved into several detailed equivalent categories in image communication, regulates and defines them.

(5) Data structure and coding

DICOM standard provides dedicated medical image files. The formats are regulated specifically in this chapter, the data used and the character encoding requirements are provided.

(6) Data dictionary

It includes all the encoding and coding instructions of data elements in the DICOM standard. The standard uses unique identifier, which is unique in all international standards, makes DICOM more workable and reduces the conflict.

(7) Message exchange

The chapter 7 defines the method of operation information objects in network communication, encapsulates the data format of information, that is, DIMSE, DICOM Message Service Element.

(8) Network communication support for message exchange

It regulates the message exchange in communication network and defines the transmitted network data and the

state transition in the OSI reference model of ISO and TCP/IP-based protocol stack.

(9) Point-to-point communication support for message exchange

The details provided in this chapter are widely used in the era when the Internet is not widespread, but it is used very less now.

(10) Media storage and file format for data exchange

The chapter 10 specifies the model and functional division of medium storing DICOM files, defines the DICOM file format, and standardizes the logic relation and encoding format of DICOMDIR catalog files.

(11) Media storage application profile

This part provides the application selection mechanism and strategies in media storage, gives the general pattern of the mechanism and some examples.

(12) Storage functions and media Formats in data interchange

The main contain includes the data formants and directory and management specifications in storage process. The more key is the DICOMDIR file which plays an important role in the directory classification of the images.

(13) Support printing management of point-to-point communication

It detailedly describes the composition and conversion of protocol data in the communication process with the printer supporting the DICOM standard.

(14) Grayscale standard display function

It has a very important basis to show parameters, print film, and display image, and can directly affect the accuracy of clinical diagnosis.

(15) Security profiles

The DICOM standard contains very detailed personal information of patients. The data security in the processes of storage and transmission is critical, and the implementation of encrypting transmission of information is necessary. In this chapter, the DICOM standard working group cites the widely used information encryption standard to promote the transmission and storage more reliable and secure[3].

III. COMPOSITION OF DICOM FILE

A. File Structure

DICOM protocol allows that we store the transmission results of data as DICOM. The typical DICOM file structure is shown in Fig. 1.

DICOM file consists of the following components.

(1) Preamble

It has 128 bytes and the file instructions can be set in this part.

(2) Prefix

The four bytes define four characters, D, I, C, M.

(3) Data element

It generally has multiple sets of data element. Each data element corresponding to an IOD attribute has four domains, namely, Tag, Value Representation, Value Length and Value Field, in which, Value Representation is optional[4].

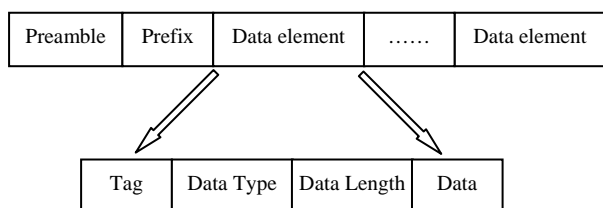


Figure 1. Typical DICOM file structure

B. Image Encoding

Pixel data element (7FE0, 0010) is the most important data unit of DICOM file, and it contains the necessary data for medical image display. The other data elements closely relating to pixel data element are as follows.

- (0028, 0008): number of image frames;
- (0028, 0010): number of image lines;
- (0028, 0011): number of image columns;
- (0028, 0100): distribution bit number;
- (0028, 0101): storage bit number;
- (0028, 0102): highest bit number.

The code of pixel data is determined by distribution bit number, storage bit number and the highest bit number, and the distribution bit number must be greater than the storage bit number. The pixel data of DICOM image is often 16-bit or 12-bit. If 16-bit format is selected, each pixel has two bytes; if 12-bit, the bytes distribution of per pixel is more complex, and we can determine the distribution bit number, storage bit number and the highest bit number by distinguishing the elements values of (0028,0100), (0028,0101) and (0028,0102).

When there are 16 distributed bits, 12 storage bits and the highest bit is 12 in each pixel, the pixel occupies only 2 bytes and uses the low 12 bits. When the highest bit is 12, each pixel uses the high 12 bits of the 2 bytes. When there are 12 distributed bits, 12 storage bits and the highest bit is 11 in each pixel, the pixel only occupies 3 bytes, the contents of the middle byte is divided into two parts, respectively, belonging to the front and back byte, then each pixel has 12 bits.

Pixel data can be compressed or not, when the data is transmitted as compressed format, the Value Representation is OB, on the contrary, the value is OW. For the uncompressed pixel data, the sequence is usually from top to bottom, from left to right and the data are encoded and stored as a continuous bit stream. For the compressed pixel data, they can be stored in segment and delimited by a series of bound items to support the image compression process with un-pre-known length.

IV. FORMAT CONVERSION AND DISPLAY OF DICOM IMAGE

DICOM standard image is a special format and it has complex types, various combination formats. Its display and processing need specially developed image processor, but the most current applications do not support it. Combining the clinical use, we find that physicians usually simply select the specific pieces of image as the

basis for conclusions in the disease diagnosis. The constituting characteristics of the image pixel data have many similarities with the common images, such as BMP, but also, the latter is suitable for image analysis, feature extraction and other image processing. On the other hand, there are still some medical images using BMP format to exchange information and diagnosis in the process of the digital hospital information construction. In order to facilitate the exchange of documents, we achieve the file conversion between the DICOM files and BMP files, the popular bitmap file in Windows system.

A. BMP File Format

BMP file consists of four parts, bitmap file header (Bitmap-file), bitmap information header (Bitmap-information), color table or palette, image data array.

Bitmap file header contains the file type, file size, storage location and other information, and it is defined by the structure BITMAPFILEHEADER in Windows, the length of this structure is fixed for 14 bytes.

Bitmap information header, the structure BITMAPINFOHEADER is a fixed length for 40 bytes.

Palette is optional. If the image has palette, it is actually an array and creates the corresponding relation between array and colors, the value is the number of colors used for the bitmap. The type of each element in the array is a RGBQUAD structure, accounting 4 bytes, it is defined as follows: 1 byte is used for the blue component, 1 byte for the green component, 1 byte for the red component, 1 byte for padding (set to 0). The image data are set after the palette[5].

If the image has no palette, the image data are after the BITMAPINFOHEADER structure.

B. Difference between the Two Image Formats

The file headers and data structures are very different in DICOM image and BMP image. DICOM image stores a lot of medical information of data elements in the data collection, such as patient name, age, hospital name, imaging time, checking site, and so on, besides the image size, height, width, number of bytes per pixel image, and other essential information.

The image data array of the two images are quite different, DICOM images are stored sequentially, the first byte of the array represents the upper left image pixels, and the last byte represents the lower right image pixels. But, BMP image is stored from bottom to top, that is, the first byte of the array indicates the lower left image pixels, and the last byte indicates the top right image pixels[6].

C. Conversion from BMP Image to DICOM Image

Comparing the BMP image with the standard DICOM image format, we can see that the BMP image includes only the characteristics of the object image corresponding to the image information in DICOM image, lacks of a range of information and other features which need be added to follow up. We can manually add them in the process of capture, can also obtain them from the patient information database. But, some characteristics of image IOD information are required to obtain from the imaging equipment, such as the current window width and

position, pixel space ratio[7]. Thus, the software programming process of converting the BMP file into DICOM file is shown in Fig. 2.

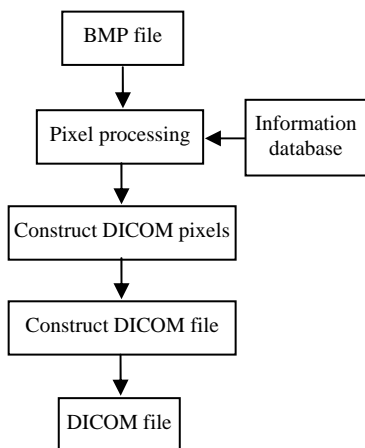


Figure 2. Process of converting BMP file to DICOM file

D. Conversion from DICOM Images to BMP Image

Firstly, we should define some parameter variables of image stored, and initialize the variables. Secondly, according to the requirements of transferring syntax, it traverses the relevant data elements of the DICOM files, then extracts the useful data elements from 0002, 0028, 7EF0 groups, respectively stores them into the previously defined variables, and closes DICOM files. It converses 12-bit or 16-bit image data into 8-bit grayscale data. Finally, it opens a blank document. In accordance with the requirements of DICOM files, the data extracted from DICOM files will be written to the new file.

The conversion process can be divided into three parts. Part one is document reading, including the basic parameters information of image and image data reading. Part two is the shift, capture, window level transformation of image data, etc.. Part three writes 8-bit grayscale image data, bitmap file header, information header and color table into the BMP bitmap file.

The process is shown in Fig. 3.

E. Problems Needed Attention

(1) To obtain image information is actually the traversal of all the data elements of DICOM file. When traversing the data elements, some information contained in data elements is irrelevant to the image, in order to improve the speed of program traversal, we can only read the useful data elements.

(2) When reading the data element (0002, xxxx), the Value Representations of all the data elements are represented, that is, Explicit VR Little Endian. As the little-endian byte order, the byte orders should be first exchanged. We should pay special attention to the data element (0002, 0010), and the value of the data element can determine the file transfer syntax[8].

(3) The image data of (7FE0, 0010) in pixel data element is generally 16-bit or 12-bit, we need adjust the window width and window bit of the original data into 8-bit grayscale data. The so-called window width is the

range of the image data display, window bit is the center value of the image data. We can adjust them according to the following equation.

$$h = \begin{cases} 0, & b - w/2 > x \\ 255, & b + w/2 < x \\ [x - (b - w/2)] \times 255 / w, & \text{else} \end{cases}$$

Where x represents the image data, y is the grayscale value of the bitmap, w is the window width, b is window bit.

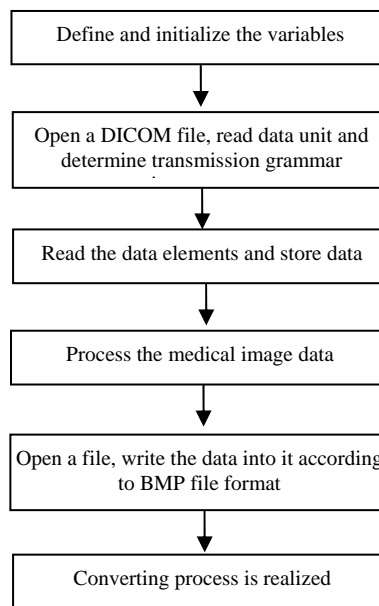


Figure 3. Process of converting DICOM file to BMP file

F. Display of DICOM Image

After the file format conversion, the medical image can be displayed. The software are programmed by using Visual C++, and the image display is implemented by the class CView[9]. The function OnDraw() can convert the image to a device independent bitmap (DIB) and the display it. The specific operations are related to two functions, BitBlt() and StretchBlt(). The former function can copy the bitmap pixels from a memory device context to display device environment or printer using logical coordinates. The latter one also copies a bitmap from one device to another scene.

The process of displaying a medical image is as follows.

- (1) Apply memory space to store bitmap files.
- (2) Read the bitmap file into the applied memory space.
- (3) Use the function CreateDIBitmap() to create and display a bitmap in the functions, such as, OnPaint(), and so on, use CreateCompatibleDC() to create compatible DC, and utilize SelectBitmap() to choose a bitmap.
- (4) Use BitBlt() or StretchBlt() function to display a bitmap.
- (5) Use DeleteObject() to delete the created bitmap.

V. GRAYSCALE PROCESSING OF IMAGE

A. Mathematical Morphology

Mathematical morphology makes the rigorous mathematical theory as the basis, focuses on studying the geometry structure and the relationship of the images. It uses a special tool, structural element, to measure the image shape and construct different structural elements to obtain different image processing results. Mathematical morphology has become a new kind of image processing theory and method, which basic ideas and methods have significant impacts on image processing theory and technology. Morphological operation is divided into binary and grayscale computing operations, respectively, corresponding to the binary image processing and grayscale image processing. Their basic algorithms include erosion, dilation, opening and closing. By using these basic algorithms and their combination, we can implement the analysis and processing of the shape and structure of image, including image segmentation, feature extraction, boundary detection, image filtering, image enhancement and restoration, and so on.

B. Window Processing of Grayscale

The grayscale images occupy most parts in medical imaging files, such as, CT images. This image only contains the information of brightness grayscale, without color information. Grayscale representation means to quantify the brightness values. Because the densities of the three-primary colors, red, green and blue, in the RGB representation, the grayscale level is usually divided into 0 to 255. 0 means the darkest (all black) and 255 is the brightest (all white). Point operation is a commonly used technology which can change the grayscale range that the image data occupy. An image can produce a new output image after point operation, and the grayscale range of the input pixel determines range of the output pixel.

If the input image is $A(x, y)$ and the output image is $B(x, y)$, then, the point operation can be expressed as:

$$B(x, y) = f[A(x, y)]$$

Where the function $f()$ is called grayscale transformation function, which is used to describe the conversion relationship between the input and output grayscale values. The point operation can be completely determined if the grayscale transformation function is made.

The window processing of grayscale is to limit a window range. The grayscale value remains unchanged in the range. The value is set to 0 if it is smaller than the lower limit, and it is 255 if greater than the maximum.

The expression of the function of the window processing of grayscale is as follows:

$$f(x) = \begin{cases} 0, & x < M \\ x, & M \leq x \leq N \\ 255, & x > N \end{cases}$$

Where M indicates the lower limit of the window and N represents the upper limit.

C. Grayscale Operation

The object of grayscale operation is image function and the structure element is a grayscale form of a small window, that is, the grayscale value of each point in the window need be determined when the window is

determined. The current point of the image corresponding to the form operation is usually made as a center in the structure elements.

In the following paper, we assume that the input image is f , the structural elements is g , D_f and D_g are the domains of f and g , s and x are the vectors of an integer space.

Erosion operation is one of the basic algorithms of the mathematical morphology. In the macroscopic view, the erosion operation can reduce the processed image. In other words, the function of erosion in mathematical morphology algorithm is to remove the image border. For example, we use the structural elements of 3×3 (in pixels) to corrupt an image, the border of the image will be reduced one pixel.

As a result, we can obtain an important conclusion that we can remove the image of these pixels by the erosion operation if the structural elements used for erosion are larger than some of the image pixels. Take advantage of this conclusion, we can choose different sizes of structural elements to remove the pixels with different sizes of the image. Moreover, we can separate the two pixels if there is small connectivity between two image pixels through the erosion operation.

The concrete realization process of erosion operation is the process of using structural elements to fill image. This process depends on shift which is a basic Euclidean space operation.

The erosion operation of g on f can be defined by the following equation.

$$(f \ominus g)(s) = \min \{ f(s+x) - g(x) \mid_{x \in D_g, (s+x) \in D_f} \}$$

Erosion operation is carried out point by point and the computing involves the values of grayscale value and structural elements of the points around it. The operation result is the difference of grayscale values between a local point and the corresponding one in structure element, and we should select the minimum one.

There are two types of effects of the erosion to grayscale image if the values of all structural elements are non-negative.

(1) The image is darkened.

(2) The effect will be weakened if the size of brightened detail of the input image is smaller than the structure element and the weakened extent depends on the grayscale value surrounding these brighten details and the shape and amplitude of the structural elements. The grayscale value of points which grayscale value of edge part is relatively large by the erosion operation can reduce. Then, the edge will draw back to the areas which grayscale value is greater than adjacent areas.

The dilation is the dual operation of inverse operation of erosion, and it can be seen as the erosion operation to the complement set of the original image.

The dilation operation of g on f can be defined by the following equation.

$$(f \oplus g)(s) = \max \{ f(s-x) + g(x) \mid_{x \in D_g, (s-x) \in D_f} \}$$

The computation of dilation operation is also carried out point by point. The operation result is the sum of grayscale values of a local point and the corresponding one in structure element, and we should select the

maximum one. Contrary to erosion, dilation can increase the grayscale of the whole image. The results of dilation operation of the parts which grayscale values change greater have larger difference contrary to the original image. For the parts which grayscale values change more gently, the grayscale of all points change very little in addition to increasing the size of core values by dilation operation. After dilation operation, the edge has been extended[10].

As same as erosion operations, we can get different dilation results to the given object image when taking different structural elements.

The role of dilation operations in mathematical morphology is to combine the background points around the image into the image. If the two objects are very close with each other, the dilation operation can cause two objects connect together. Dilation is useful to fill the holes after image segmentation.

Erosion and dilation are not reciprocal and their combination constitutes the other two basic mathematical morphology operations, opening and closing, the former is first erosion and last dilation, and the latter is first dilation and last erosion.

D. Program Implementation

The program implementation of erosion operation and dilation operation are not difficult[11]. The part code of erosion using Visual C++ is given as follow.

```

for (h = 1; h < hei - 1; h++)
{
    for (w = 0; w < wid; w++)
    {
        pSou = ( char* ) pBit + wid * h + w ;
        pDest = ( char* ) lpNewDIB + wid * h + w ;
        p = ( unsigned char ) * pSou ;
        if ( p != 255 && *pSou != 0)
            //grayscale detection
            break;
        *pDes = ( unsigned char ) 0 ;
        for ( m=0; m < 3; m++)
            //operate for 3x3 structure element
            {
                for ( n=0 ; n<3 ; n++)
                {
                    if (strct [m][n] == -1)
                        continue;
                    p = *(pSou+((2-m)-1)*wid+(n-1));
                    if(p==255)
                    {
                        *pDes=(unsigned char)255;
                        break;
                    }
                }
            }
    }
}
}
}

```

VI. EDGE DETECTION OF IMAGE

A. Edge Detection

Edge detection is a basic problem in computer vision and image processing which objective is to identify the points which brightness changes apparently in digital images or to use an algorithm to calibrate out the image edges.

The significant changes of image properties often reflect the important events and changes of properties.

- (1) The discontinuity of depth;
- (2) The discontinuity of surface orientation;
- (3) The changes of material properties;
- (4) The changes of scene illumination.

With the development of computer technology and artificial intelligence, the demand on edge detection should focus on the whole image, not be limited to the point of discontinuity of grayscale. The future trend of edge detection is the combination of doctor's experience and advanced technology and the practical and efficient methods of edge detection[12].

B. Methods of Edge Detection

There are many methods for edge detection which can be divided into two categories, search-based and zero-crossing-based.

The edge detection method based on search first calculates the edge strength, is usually expressed with the first derivative, and then, estimates the local edge direction by calculation, usually the direction of the gradient, and uses this direction to find the maximum value.

The edge detection method based on zero crossing can locate the edge by finding the zero-crossing point of the second derivative of the image. We usually use Laplacian operator or nonlinear differential equations to get it.

As the preprocessing of edge detection, filter is usually necessary and Gaussian filtering is often used.

C. Edge Detection of DICOM Image

In order to ensure the quality of edge detection, we do not directly binary the raw data of DICOM image in this method of edge detection, but first do opening and closing operations by making them as grayscale images, which requires to adjust the data range and variable types of grayscale operations by morphological, so as to meet the features of large scope of DICOM image data relatively.

In order to improve the operating speed, we should change the edge detection algorithms. Because the erosion operation scans the entire image according to the order from top to bottom, from left to right, while the difference operation also do scan the whole image. By analyzing the process of erosion operation, the subsequent erosion operation is only relevant to the original data and structural elements and is not affected by the result of erosion operation. We can modify the erosion algorithms and combine erosion and making difference. After changing the rules of erosion computing, the result is the edge image by scanning the whole image only once, and the efficiency is improved. In addition, before edge detection, by opening and closing the binary

data, we can smooth the edges and reduce operating amount of following operation[13].

The specific steps of edge detection to DICOM image are as follows.

(1) Preprocessing

The opening and closing operations of grayscale are carried out to DICOM image data. The operations can realize the functions of clipping and filling valley to local area of image, and can remove noise, smooth grayscale of the body target to facilitate the separation of the image and enhance edges.

(2) Binary

The data distribution of different tissues and organs of DICOM image has relatively fixed regional range, so we can do the threshold segmentation for the result of the first step according to the medical knowledge not to grayscale histogram, and get the binary image. Because only the edge detection is carried out, binary processing of image can simplify the calculation and increase the running speed.

(3) Smooth edges and do binary opening and closing operations.

Although the edge of human tissue is generally smooth, there are sharp corners, burrs, and so on, due to the noise effects and the limitations of imaging technologies. Binary opening and closing operations can smooth the edges.

(4) Edge detection

We do erosion operation, get the difference between the data before and after operation and detect the edge information. Although the morphological method can achieve better results, there are still many deficiencies. Such as, there are extra pseudo-boundary and needless inner boundary in the image. The edge image got by the above method is still dot-matrix data, and it is very difficult to exclude the inner boundary. This method has filtered a lot of noise information. If using larger structural elements, we can reduce the number of pseudo-boundary, but the computation will be larger and the quality of the real boundary will be impacted. To resolve these problems, the processing steps should be added. After the vectorization of the dot-matrix data, we will do specific treatment according to the features of various types of boundary and get satisfactory results.

(5) Contour extraction

Contour extraction means to vectorize the edge lattice vector. The method is to search along the image boundary, to store the coordinates records of points searched on the boundary in the points list. The result is that each contour line is represented as a point column. The boundary in the edge image got by this method is closed and single-pixel wide. We can use the more efficient eight-step tracking algorithm to vectorize them.

(6) Edge classification

The length of pseudo-boundary is generally shorter, and we should determine it is outer or inner boundary, which can be discriminated by points of the contour line. If choosing contour as starting point, we can make a ray to any horizontal direction and determine the crossing point of this horizontal ray and the other contours. If the

number of crossing point is odd, then the contour represents the inner boundary; or the number is even, then the contour line represents the outer boundary. In this method we can remove the needless inner boundaries.

VII. IMPLEMENTATION OF IMAGE PROCESSING SOFTWARE

The interface of the DICOM medical image processing software based on Visual C++ is shown as Fig. 4.

The result image showed by medical image conversion almost retains all important medical information of the original DICOM images. The software can process the images with a variety of forms, such as, flipping, inverting, grayscale, rotation, middle color, saturation, intensity detection, and so on. It offers a convenient and practical tool to learn how to parse the DICOM standard and complete medical diagnosis.

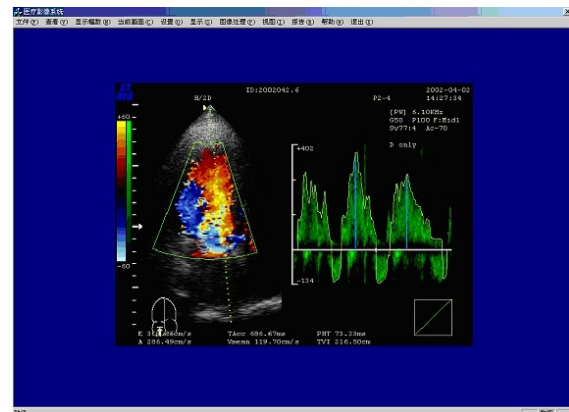


Figure 4. Interface of image processing software

VIII. CONCLUSION

As an international standard of medical image archiving and communications, DICOM is the basis for all medical imaging technologies. It is very important to study DICOM standard and file format. Based on the analysis of DICOM format and file composition, DICOM format is converted to BMP format and the medical image is displayed in Windows, and many processing operations, such as grayscale, edge detection, and so on, are realized to the medical images. The experiment proves that the system can achieve a better display and processing for DICOM medical images provide good conditions for the clinical diagnosis of doctors and digital storage, and communications of image, besides, it can lay the foundation for subsequent work. The system can run stably, has strong adaptability and can be connected well with PACS.

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