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# The design and realization of a medical image management system based on IDL platform

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## ABSTRACT

Medical image management system plays a significant role in such aspects as assisting doctors to diagnose, simulating operations and guiding the treatment and is a hotspt for researchers related. An extendable medical image management system for 3D medical data field is designed and realized in the IDL platform based on analyzing its functions and characteristics. First, the system designs a series of preprocessing methods suit for the specific characteristics of volume medical image; Then, the system advances and adopts feature region segmentation and data mining clustering and other methods to segment 3D medical image directly, and two levels projection of sorted voexl block and other methods to volume rendering image; Finally, some realization images show that the system can rendering and manage 3D medical data field conveniently and effectively in the ordinary personal computers.


## KEYWORDS

Image management system;
3D medical image segmentation;
Volume rendering, IDL platform.

## INTRODUCTION

Medical image management system, also called medical visualization, refers to the theory, methodology and technology of displaying on the screen and analyzing interactively the graphs and images transformed from the volume data measured by medical instruments with the assistance of computer graphics and image processing techniques. It avails itself of two-dimensional images of medical slices to reconstruct three-dimensional image models for qualitative and quantitative analysis, enabling the medical scientific and technological workers to acquire the structure information of 3D organs from two-dimensional images and helping people to expand their two-dimensional observation and understanding of medical images to those of three-dimensional. At the same time, it provides users with more accurate display means and quantitative analysis tools, helping people to observe the interior tissues and organs from the exterior body and making it possible to understand the interior structure of human body thoroughly and directly. As a powerful assistant device, medical visualization technology has overthrown the traditional imaging mode of film sensitization, and complemented the medical imaging instruments, providing three-dimensional medical images with better sense of reality for users to conduct multi-aspect and multi-layer observation and analysis and to participate in the course of data processing and analysis more efficiently.

In other countries, a number of merchandised systems concerning the above have been available, most of which are, nevertheless, based on the nonage algorithms for data field visualization and impose very high requirements on the running environment with sophisticated computer systems and exorbitant auxiliary software and hardware equipments. In our country, researches commence relatively late and no mature commercial system is available presently. Therefore, it is of great significance to develop applied basic researches in this field. This paper, with reference to the latest research findings in the related fields, makes an attempt to research the design of a medical image management system, mainly focusing on such aspects as direct segmentation of three-dimensional medical data field, rendering acceleration and rendering quality enhancement and comes up with a version of medical image management system based on the IDL platform, which is capable of functioning on an average PC platform with a basic configuration.

## FUNCTIONS AND CHARACTERISTICS ANALYSIS

### Functions of the system

The major functions of medical image management are as follows: to input two-dimensional image serials generated by such equipments as CT and MRI, to preprocess (including filtering of waves, interpolation between cross-sectional images, and so on), to segment and extract tissues, to reconstruct three-dimensional geometric models of pathologically changed, sensitive and important tissues for the segments, and to activate the three-dimensional models' functions such as rotation, zooming, cutting and stereo clipping. Figure 1 offers a diagrammatic sketch of the major functions of a medical image management system.

### Structure design of the system

IDL, or Interactive Data Language, is an ideal software for data analysis, visualization representation and applied development with its extraordinary superiority in image processing and rendering. Since it totally embraces matrix, IDL is capable of quick analysis of exceedingly giant volumes of data and visualized analysis of any data.

The volume rendering system discussed is developed on PC with a basic configuration of a P4 1.6 G CPU, a 1G memory and a 3D acceleration card, the operation system being either Window XP. Design of the whole system is done in the IDL 4.0 integrative environment. Figure 2 shows the basic framework of the software.

### The Requirements of designed system

### (1) Real time

All the medical image management systems aiming for application have high demands for being real time. Usually its display rate of images must be no less than

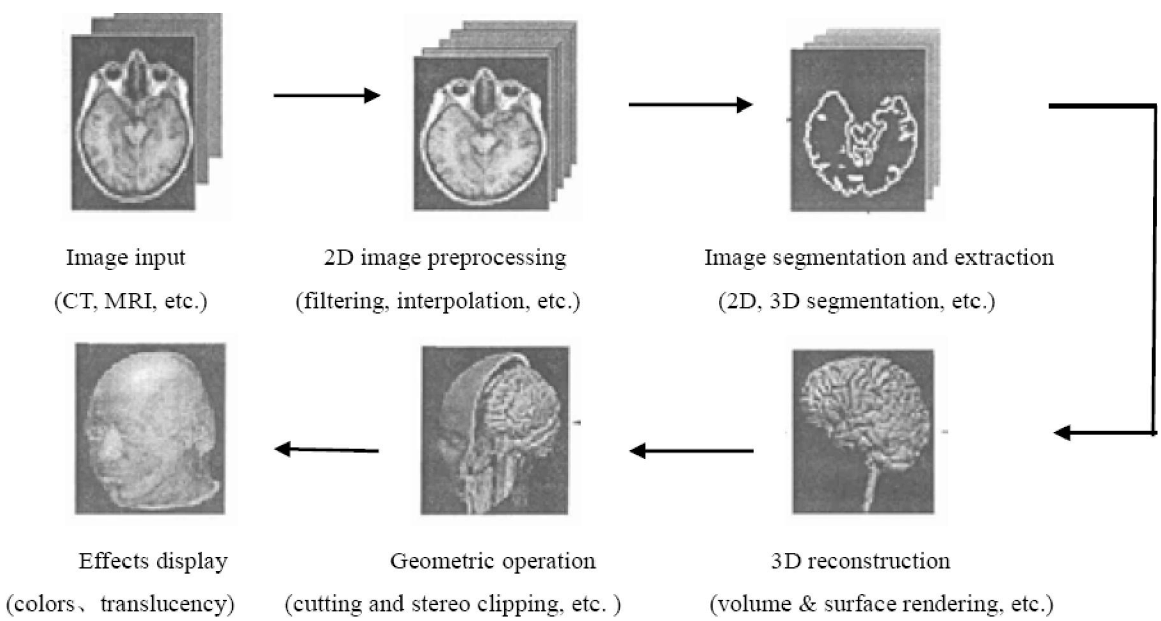



**Figure 1 : A medical image management system diagrammatic sketch**

ten frames per second. However, as for the visualizations tasks with data of great volumes, such as the medical CT data with an average size of 256*256*256, support from such graphic hardware as SGI workstation or graphic card with algorithms for integrative visualization is needed to be real time.

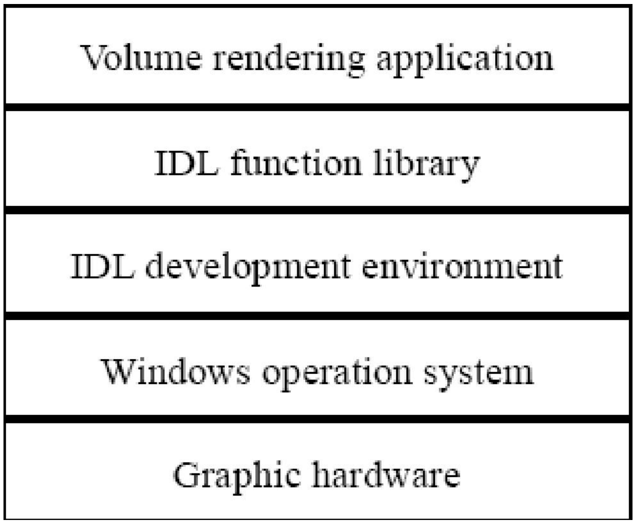



**Figure 2 : The designed system structure graph**

### (2) Interactivity

Interactivity is another basic requirement for the application system. When designing the structure for the three-dimensional medical image management system, this paper digs into the interactivity of rendering function modules. User input is able to control several key stages of the rendering process, for example, to choose Interpolation algorithms, to lower the image quality in compensation for rendering time, to choose synthetic algorithms to review different image results produced from different synthetic technology, or even to control the opacity of data fields to adjust rendering effect according to the user's visual sense.

### (3) Independency from the platform

Independency from the platform is the dream for the designers of every system, and the basic requirement of every user for the application of the system as well. The development of the system here is based on the IDL software development environment without the support of any specialized graphic card. With the excellent IDL feature of independency from the platform, the system is provided with an eminent transplant ability.

## FRAMEWORK DESIGN OF THE SYSTEM

### Categorization of system function modules

After preprocessing and segmenting the input images serials from such instruments as CT and MRI, the medical image management system reconstructs a three-dimensional surface model and then makes further operations such as zooming, rotation, cutting and stereo clipping. The main function modules of this system are illustrated in Figure 3.

### Acquisition and input of images

The acquisition and input of images means to load the two-dimensional cross-sectional serial images generated by physical equipments and to transform them into a data file to facilitate other management modules. Despite the different forms of data generated by medical equipments, this system module might read all of them, bmp, jpg, tif, gif, dicom, for instance, conveniently and afterwards transform them into data files or arrays independent from any equipment through such processions as cross-sectional image registration, image format transformation and image normalization.

### Preprocessing of two-dimensional images

Usually, it is impossible for original data obtained from medical instruments to be inputted directly into visualization function modules, so transformation preprocessing of the data is indispensable. Therefore, the content of the module is the technological basis for the following processes. Utilizing the available technological achievement of image processing, the medical image management system designs a series of reasonable transformation preprocessing methods with regard to the actual physical features of medical images.

When reading the image serial, the system introduces such preprocessing methods as saving data with DICOM 3.0 protocol, mid-value theorem, edge-preserving filtering, histogram image equalization and 2D bicubic spline interpolation between slices. Then, after resampling, the system encapsules the two-dimensional image serial into regular data field, also termed as three-dimensional medical image, which provides materials for the following tissue segmentation and rendering in three-dimensional space.

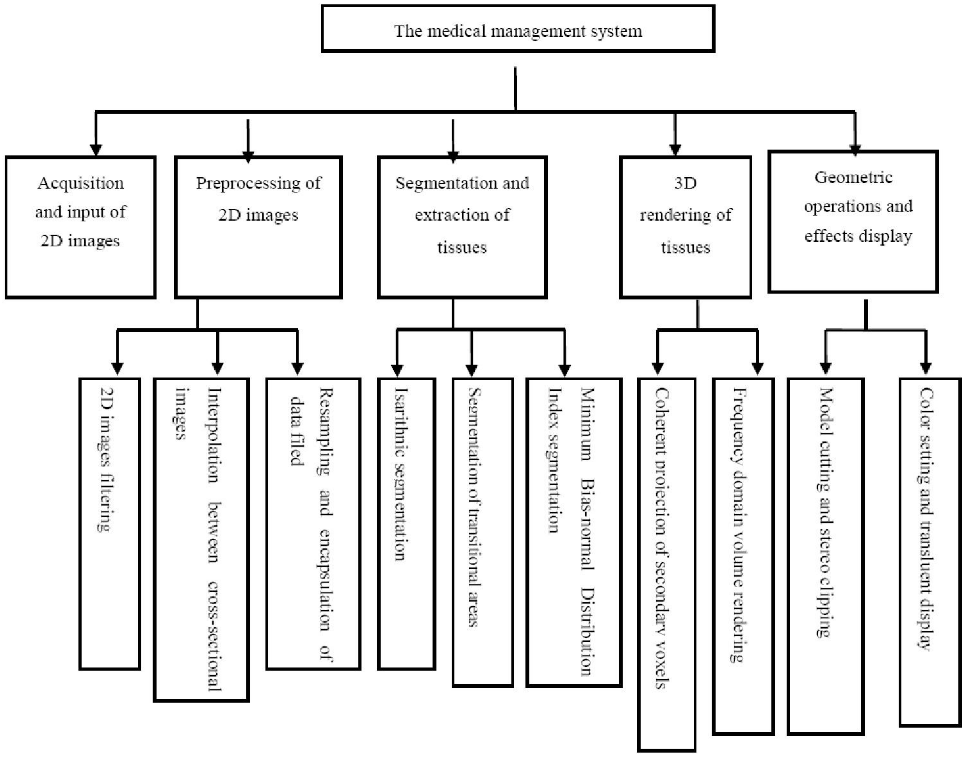



**Figure 3 : The function module structure of the system**

In view of the scale of the image data being loaded and the computer's processing ability and speed, the system compresses the scale of data to improve the visualization speed on the premise that the accuracy of segmentation and reconstruction of tissues or organs meets the cure requirements. A case in point is a two-dimensional cross-sectional image with 1024*1024 pixel can be compressed as that of 512*512 or 256*256 through the means of dot interlaced sampling. Therefore, in the condition that layer numbers of cross-sectional image serial remains the same, the scale of the image date can be compressed into one-fourth or one-sixteenth of the original.

## Segmentation and extraction of tissues or organs

The system incorporates interactivity of images and actualizes tissue segmentation and extraction based on data partitioning and clustering to conduce the following respective rendering. On the basis of image features and modality features of the waiting tissues or organs, this system realizes such segmentation methods as those directly aiming at three-dimensional medical data field based on the transitional characteristic region of three-dimensional medical data field as well as on the medical fuzzy edge and date mining.

## Rendering of tissues or organs

In order for better understanding of volume data, the system introduces many imaging ways of slice rendering, surface rendering and volume rendering. Algorithms for medical visualization generally falls into two categories, surface rendering and direct volume rendering. The former is to extract an iso-surface according to the assigned threshold value and then to render in the traditional way of curve surface shading. The latter is to project the data field directly on the image plane as a whole for an overall image of the data field. Constructing in-between geometric primitive is unnecessary here to generate images with high quality and sense of reality, while surface rendering fails in this part. The disadvantage with direct volume rendering lies in the fact that high-powered acceleration algorithm is required because it is quite time-consuming to go over the whole data field for every image generated.

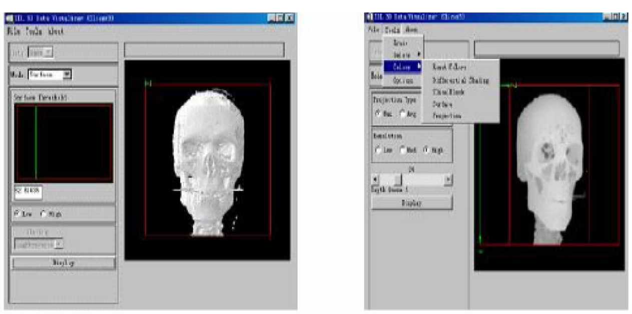
Focusing on direct volume rendering, this system takes advantage of the medical tissues and organs' feature of smooth transition and introduces the algorithm of coherent projection of secondary sorting voxels which can improve rendering speed without lowering the rendering quality and the algorithm of frequency domain volume rendering which can improve edge volume rending.

### Interactive rendering

Volume interactivity is the best way to understand volume data solidly, with the system's interactivity being incorporated in every image module. This system mainly uses the technology of tracking ball to realize interactivity and is capable of rotating to any direction, translating, zooming as well as modulating colors and opacity interactively.

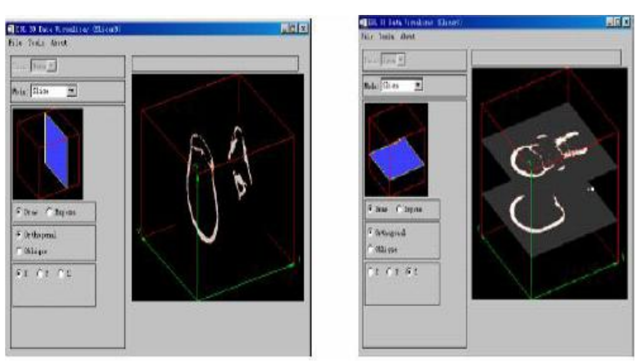
### Tissue localization

Localizing pathological changes is of great importance in medical diagnosis. Giving plenty of consideration to medical practices in the course of imaging, the system can localize data conveniently, measure the size of the tissue localized, to cut the reconstructed model in a given plane and to get the shape of the cutting plane. Since interior tissues can be seen through the cutting of exterior tissues, stereo clipping is to cut a clip in the exterior tissue through which the interior tissue can be seen.



(a) Effect diagram of surface rendering (b) Effect diagram of volume rendering

**Figure 4 : Comparison diagram of the effects**

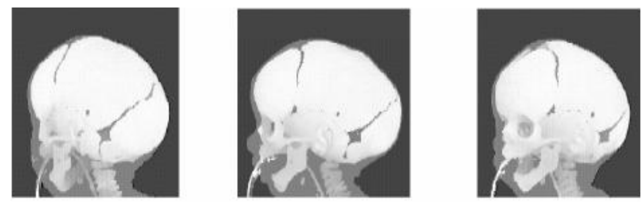


(a) Effect diagram of slices X axis direction (b) Effect diagram of in slices in Y axis

**Figure 5 : Effect diagram of volume rendering and slices in every direction**

## PART DEMOSTRATION OF THE SYSTEM

Comparison between the effect of surface rendering and volume rendering can see Figure 4; effect diagram of volume rendering before slicing and slices in every direction. Can see Figure5; effect diagram of positive and negative angles of Z-axis rotation can see Figure 6.



(a)$\alpha = 0°, \beta = 0°, \gamma = 30°$ (b)$\alpha = 0°, \beta = 0°, \gamma = 0°$ (c)$\alpha = 0°, \beta = 0°, \gamma = -30°$

**Figure 6 : Rendering effect diagram of Z-axis rotation of data field**

## CONCLUSION

This paper designs and realizes a 3D medical image management system based on the IDL platform with reference to the latest research findings in visualization and other related fields, and offers several effect diagrams of the system. The test results show that the system is capable of representing all the information of the visualization tissues authentically on the platform of an average PC. Furthermore, thanks to the modularization structure in design, the system's independence in functional structure is ensured, new function modules can be added conveniently. Consequently, three-dimensional medical data field visualization can be easily and conveniently rendered and managed.

## REFENENCES


**[1]** H.Ray, H.S.Pister; Ray-casting architectures for 3D visualization, IEEE J.Comp.Grap., **3**, 210-223 **(2009)**.

**[2]** K.T.Lohmann, E.G.Gundelfinger; Brain viewÿA computer program for reconstruction and visualization of 3D data sets, J.Neur.Meth., **84**, 143-154 **(2008)**.

**[3]** X.W.Li, C.Y.Hao; A new projection algorithm based on feature region, J.Soft., **54**, 78-83 **(2012)**.

**[4]** X.W.Li, C.Y.Hao; An algorithm for improving image quality. J.Comp., **21**, 329-331 **(2011)**.

**[5]** T.K.Castel, K.D.Foster; Cell project algorithm based on fuzzy segmentation of Medical. J.Syst.Simu., **35**, 1922-1925 **(2012)**.

**[6]** A.S.Smith; A study of medical visualization rendering technology based on image segmentation. J.Comp.Simu., **29**, 77-86 **(2010)**.

**[7]** D.F.Huile; Color assignment and boundary sharpening in frequency domain volume rendering. J.Imag.Grap., **55**, 240-252 **(2010)**.