3D RECONSTRUCTION OF 2D MEDICAL IMAGES FROMDICOMS FILES

K. Praveen Kumar, . M.S Anuradha , Department Of Electronics And Communication Engineering, Andhra University College Of Engineering,Visakhapatnam

ABSTRACT

This paper presents the converting (2D) medical image data (Digital Imaging and Communications in Medicine (DICOM) files) to 3D model is presented. Medical data and image processing software namely MATLAB were used. The techniques such as Multiplanar, surface render, volume reconstruction, and image segmentation were used to reconstruction and approached for the best results. 3D reconstruction of medical images is one of the advancements in physical modelling techniques which uses engineering methods in the field of medicine. The purpose of development a software tool that will help in Robotic surgery. The existing approaches for 3D reconstruction has different applications from real scenery to human parts of the body. The implementation of different algorithms allows developers to make vital decisions in understanding the surgery. The human body has different regions including the hard bones and tissue. It presents the different 3D reconstruction approaches and for analyzing the suitable approach for a specificrange of application are presented.

1. INTRODUCTION

To perform low risk surgery and accurate has led to the discovery of computer based on planning to surgery. Three-dimensional (3D) computerized tomography (CT) images are important resources that provide useful internal information about the human body to support diagnosis, surgery, and therapy. Fully automatic image segmentation is a fundamental part of the applications based on 3D CT images by mapping the physical image signal to a useful abstraction. It requires a pre-operative study as well as the simulation of surgery which predicts the output of the surgery. It helps doctors in taking right decisions even before performing the surgery. It helps to view the portion in 3D which is suspected to be infected by abnormality. It is a surgical subdiscipline of plastic surgery which deals with manipulation of bone.

2. LITERATURE SURVEY

Eva Hnatkova, Petr Kratky and Zdenek Dvorak [1], Present a process to Convert medical datafrom 2D to 3D using one of the advanced conversion programs called Mimics and re-edit them until they are ready to print three-dimensional images, identical to human body anatomy. Yet, thetool usedin the conversion does not fit with all cases of DICOM images.

M. Usman Akram, Aasia Khanum and Khalid Iqba [2], Provides a method for improving and dividing the liver using CT imaging by a global threshold and a set of equations to improve the liver image in terms of clarity and noise removal, while maintaining the size, density and shape of the liver. Yet, it is not easy to use the equations constantly,the image is almost accurate and requiers the intervention of some tools for more accurate drawing of equations.

Hongjian Shi and Rachid Fahmi [3], a study of liver tissue deformities using the current limit of F.E. by using high-resolution images of CBCT. Analysis of distortion rates through different linear models, and test of image distortion rates compared to simulation distortions. He explained that the flex line model is the best way to calculate the proportion of distortions and weight

Van Sinh Nguyen, Manh Ha Tran , Hoang Minh Quang Vu [4], Presents a survey of The DICOM digital image conversion, provides a three- dimensional model of digital and cross-sectional imaging and the use of the VTK library to analyze and construct the three-dimensional model.

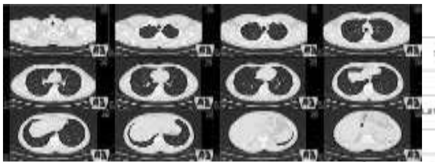
Laura Mazzotta, Mauro Cozzani, Armando Razionale, Sabrina Mutinelli, Attilio Castaldo, and Armando Silvestrini-Biavati,[5] Present a survey of the formation of a three-dimensional model of dental roots without the use of CBCT,while reducing the radiation rate to maintain the health of the patient and provide three-dimensional information at the level of accuracy is acceptable statistically and clinically. However, the quality of the crown of the parametric model is weak, taking into account the various parameters (lengths of tendons, roots and widths) measured by CBCT

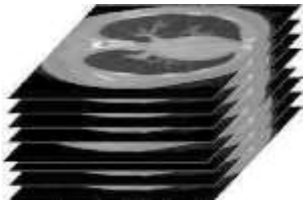
3. METHODOLOGY

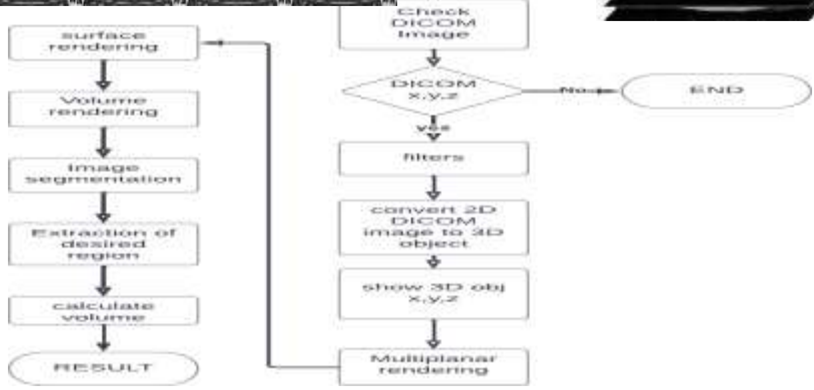
I. Datasets

The Picture Archiving Systems (PACS) utilizes a Relational Database Management System (RDBMS) to store and recoverDICOM information. DICOM files stores huge patients' information. Extracting and recovering this huge information from substantial vaults is very unpredictable and testing. Moreover, it enhances territories like research, treatment strategies, persistent likeliness seeking, illness movement checking, clinical development, contextual analyses, preparing and learning, ability sharing and comprehends diverse examples in the medicinal picture information filein a secure way.

Fig:1 Digital Imaging and Communication of Medical Standard Fig:2 DICOM Layer







II. FLOWCHART

The three dimensional techniques in medical imaging can be broadly classified into multi planar rendering (MPR), surface rendering (SR) and volume rendering (VR), and Image segmentation

III. MULTIPLANAR RENDERING

Multi planar reformatting (MPR) is a technique that is used to visualize the grey values inarbitrary cross sections through the volumetric data. MPR is actually a two-dimensional reconstruction of a CT image in a different plane. The axial slices are allow to view the entire structure from the side or from front to back rather than as an axial slice cut across the structure. The relationship of the organs to each other are shown in a different view along with a view of an entire tumor in another plane may help determine treatment options. The main advantage of the multi-planar reformatting method is that one is not restricted to viewing in the direction the data was scanned, which makes it possible to visualize data that was measured in different slices in two-dimensional image.

IV. SURFACE RENDERING

Surface rendering is a way to visualize the object by means of the image data as a hard set of certain basic elements, such as voxels, their faces, other polygons, line segments, and points. These sets representeither the boundary of the structure or the entire structure. An iso-surface is a three- dimensional analog of aniso-contour. It is a surface that represents points of a constant value. Two popular methods of constructing an iso-surface from a data volume like CT/MRI scan of humanbody are Contour based surface reconstruction and iso-surface extraction algorithms .

A) Contour based surface reconstruction

Contour based reconstruction consists of Iso-contours,which are extracted from each slice can be connected to create iso-surfaces. It is a process of constructing a surface over a set of cross-sectional contours. This surface, to be composed of triangular tiles, is constructed by separately determining an optimal surface between each pair of consecutive contours. For reconstructing the three- dimensional structure, a simple manual method is sometimes employed. The images are transferred to photographic transparencies sized for table-top observation and are stacked in sequence with transparent spacers of appropriate thickness. The resulting semitransparent stack roughly approximates the original three-dimensional structure and can be examined from various angles. The contour points determined can be reduced to constructing a sequence of surfaces, one between pair of adjacent contours.

B) Iso surface Extraction

The two primary steps are locating the surface corresponding to a user specified value and create triangles. Then calculate normal to the surface at every vertex of triangles to ensure the quality of image. The algorithm determines how the surface intersects the cube, then marches to the next cube. To find the surface intersection in a cube, we assign one to a cube's vertices if their data value exceeds or equals to the value of the surface we are reconstructing, and consider them as inside vertices. Cube vertices with values below the surface receive a zero and are consider them as outside vertices.

a) Segmentation of the given slices to get the relevant information.

b) The output of segmentation is given as the input to the MC algorithm which produces proper iso surface which is required.

c) The whole voxels created will be searched. But to enhance the searching efficiency,the voxels that intersect with the iso surfaces are only searched

V. VOLUME RENDERING

Volume rendering is done using Ray Casting method. In Ray casting, also known as backward mapping, a ray is fired from each pixel in the view plane, and information from all the voxels, in the volume data, intersecting the current ray or pixel is gathered. The basic goal of ray casting is to allow the best use of the three-dimensional data and not attempt to impose any geometric structure on it. It solves one of the most important limitations of surface extraction techniques. Surface extraction techniques fail to take into account that, particularly in medical imaging, data may originate from fluid and other materials which may be partially transparent and should be modeled.

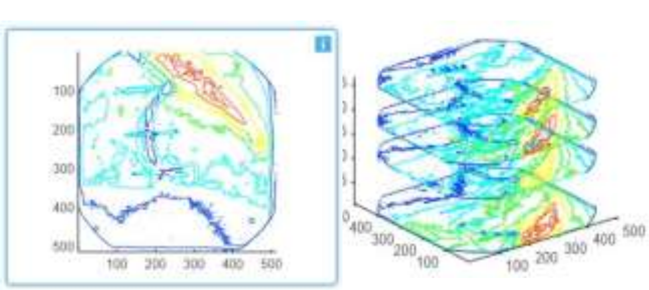
VI. IMAGE SEGMENTATION

Image segmentation is a method in which a digital image is broken down into various subgroups called Image segments which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels. All picture elements or pixels belonging to the same category have a common label assigned to them. For example: Let's take a problem where the picture has to be provided as input for object detection. Rather than processing the whole image, the detector can be inputted with a region selected by a segmentation algorithm. This will prevent the detector from processing the whole image thereby reducing inferencetime.

4. RESULTS

1. Contour based extraction

with the help of 27 axial slices that are 1.5 mm thick and pixel dimensions of 0.7mm of heart angiogram is used to reconstructed the image. In this, it have proved that between each pair of adjacent contours, surface contours can be constructed . These surfaces can be associated with certain cycles which helps in finding paths.Finding such paths reduces the search space.



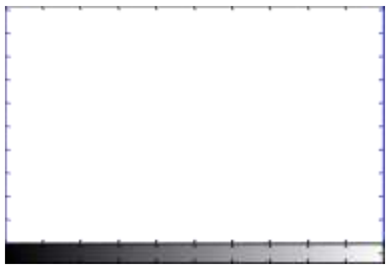


Fig:3 Optimal tiled surface defined over the contours.

Fig:5 Histogram of contoured image

2. Multiplanar rendering.

With the help of 64 CT axial slices that are 1.5mm thick and pixel dimensions of 0.8mm, CT images of 77 axial slices of 1.9mm and SPECT study consisting of chest is used to visualize the grey values inarbitrary cross sections through the volumetric data. It allows to view the entire structure from the side or from front to back rather than as an axial slice cut across the structure

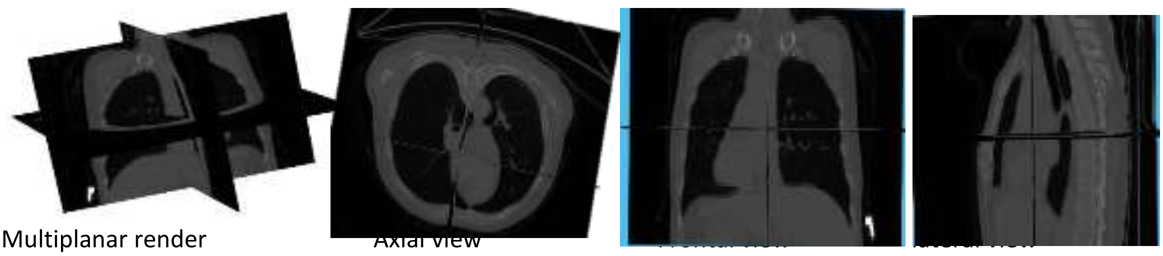


Fig 6 Multiplanar render Axial view

3. Iso surface Extraction

With the help of 512×512×64(12 bit) CT images, that the Improved Marching Cube algorithm reduces the quantity of triangular patches generated and ittook less time to finish the reconstruction. The algorithm determines how the surface intersects the cube, then marches to the next cube. To find the surface intersection in a cube, assign one to a cube's vertices if their data value exceeds or equals to the value of the surface reconstructing, and consider them as inside vertices. Cube vertices with values below the surface receive a zero and are consider them as outside vertices.

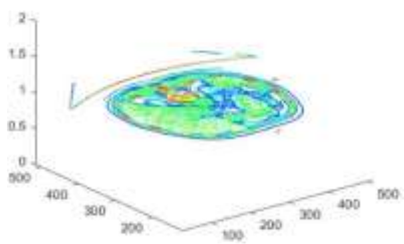


Fig:7 Iso Surface Extraction from single slice

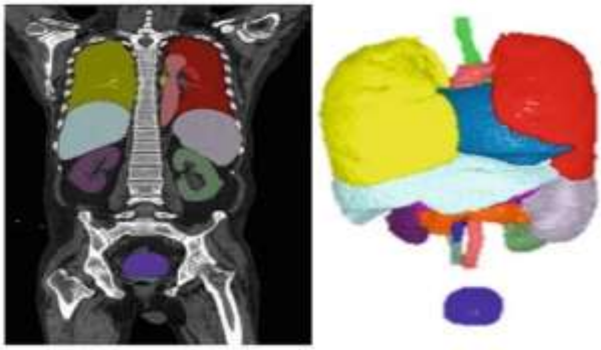


Fig:8 Iso surface Extraction

4. Volume render

With the help of DICOM CT data sets of Ankle which are of size 512×512×374×2with 0.625000 slice thickness, constructed a 3D image. It solves one of the most important limitations of surface extraction techniques, namely the way in which they display a projection of a thin shell in theacquisition space. techniques fail to take into account that, particularly in medical imaging, data mayoriginate from fluid and other materials which may be partially transparent and should be modeled.

Fig:9 Volume rendering of hard tissues

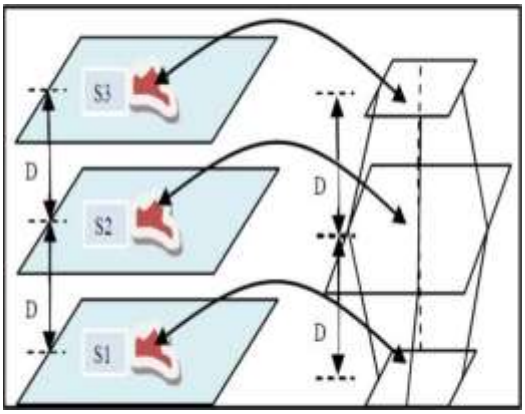


Fig:10 Volume reconstruction from slices

Conclusion

Among the different 3D reconstruction algorithms such as multiplanar, contour based extraction , Isosurface Extraction and Volume render , concluded that Isosurface Extraction Algorithm is the best method to reconstructed the 3D image from the 2D Digital imaging and communication of medical standards based on the aspect of visualization of the outermost layer of the each organ andit also easy to identify the difference between the different regions of the 3D object.it also helpful to separate the desired region or any abnormality found in the object.

REFERENCES

[1] Eva Hnatkova, Petr Kratky and Zdenek Dvorak "Conversion of 2D medical scan data into 3D printed models," *Advances in Environmental Sciences, Development and Chemistry,* p. 315– 318, 2014.

[2] M. Usman Akram, Aasia Khanum and Khalid Iqbal , " An automated System for Liver CT Enhancement and Segmentation," ICGST-GVIP Journal, vol. 10, no. IV, pp. 17-22, 2010.

[3] Hongjian Shi and Rachid Fahmi , " Energy Minimization within the F.E. Framework to Predict Liver Tissue Deformation," in GVIP 05 Conference, Cairo, Egypt, December 2005.

[4] Van Sinh Nguyen, Manh Ha Tran and Hoang Minh Quang Vu, "A Research on 3D Model Construction from 2D DICOM," in International Conference on Advanced Computing and Applications (ACOMP), Can Tho, Vietnam, 2016.

[5] LauraMazzotta, Mauro Cozzani, ArmandoRazionale, SabrinaMutinelli, AttilioCastaldo and andArmandoSilvestrini- Biavati, "From 2D to 3D: Construction of a 3D Parametric Model for Detection of Dental Roots Shape and Position from a Panoramic Radiograph—A Preliminary Report," Hindaw iPublishing Corporation, International Journal of Dentistry , vol. 2013, 2013.

[6] Doi, K.: Computer-aided diagnosis in medical imaging: historical review, current status andfuture potential. Comput. Med. Imaging Graph. 31, 198–211 (2007)

[7] Wolz, R., Chu, C., Misawa, K., Fujiwara, M., Mori, K., Rueckert, D.: Automated abdominal multi- organ segmentation with subject-specific atlas generation. IEEE Trans. Med. Imaging 32(9), 1723– 1730 (2013)

[8] Cha, K.H., Hadjiiski, L., Samala, R.K., Chan, H.P., Caoili, E.M., Cohan, R.H.: Urinary bladder segmentation in CT urography using deep-learning convolutional neural network and level sets. Med. Phys. 43(4), 1882–1896 (2016)

