3d Doctor-Pancreatic Tumor Detection And Segmentation

Visu P[1]*, Sadagopan S[2], Smitha P.S[3], Varun Kumar K.A[4]

*[1,3,] Department of CSE, Velammal Engineering College, Chennai. Email: visu.p@velammal.edu.in
[2]Department of Computational Intelligence SRM Institute of science and Technology, [2]
Email: mssadagopan@gmail.com, [3]Email: smitha.p@velammal.edu.in
[4]Department of Networking and Communications SRM Institute of Science and Technology,
Email: varun.kumar300@gmail.com
***Corresponding Author: -** Visu P

Abstract

This paper gives an efficient method to detect the tumors and its exact boundary and volume rendering in a very complex organ – pancreas, by overcoming the limitations in magnetic resonance cholangiopancreatography. Pancreas is a complex organ situated between stomach, liver, gall bladder and small intestine. Hence it is difficult to get the accurate segmentation of the tumor.2D MRI images are enhanced by appropriate filters and it is processed to get the enhanced images. These images are then modelled and propagated using 3D software package called 3D DOCTOR. The Region of Interest (ROI) can be defined in the image to get the segmentation boundary. Then the exact boundaries are automatically segmented using 3D morphological fitering techniques and this can also be done by 3D image segmentation. Since CT scans are prone to radiations frequent diagonosis may affect the normal tissues and hence MRI scans are effective. MRCP also gives 3D images but intervention cannot be possible and these defects are overcome by this method and it is a non-invasive method unlike ERCP and hence bleeding, sepsis and perforations can be avoided.

Keywords: MRI; Pancreas; Tumor; Segmentation; Volume rendering; 3D Doctor

DOI Number: 10.14704/nq.2022.20.9.NQ44139 **Neuro Quantology 2022; 20(9):1227-1231**

I.INTRODUCTION

Pancreas is a significant organ and its malfunction leads to several diseases. Tumors in pancreas are more common nowadays and the National Cancer Institute estimated that 46,385 peoples are affected by pancreatic cancer by the year 2014[1]. Tumors in pancreas may occur in exocrine or endocrine glands, exocrine tumors also known as adenocarcinoma are more common which is found in the lining of pancreatic ducts[2]. Some of the significant symptoms of pancreatic cancer are unintentional weight loss, pain in abdomen, jaundice, loss of appetite. Cigarette smoking is considered as one of the important cause for pancreatic cancer. Some of the other reasons are high cholesterol content, more alcohol consumption, obese condition, diabetics and some rare genetic conditions. Pacreatic tumors are more predominant in women than men and mostly diagonised in people with median ages around 40 to 75[3].

Tumors are generally classified into three types based on some criteria. If the tumor remains in one area and it shows limited growth then it said to be benign tumor and it can be detected easily and removed. If the next stage of the tissue forms cancer that is, a precancerous stage is said to be premalignant tumor and it is generally not dangerous if treated early [4]. If the size of the tumor increases or if it grows then it is said to be malignant tumor and it more dangerous that leads to death if untreated. Malignant tumors may further divided into two types, they are primary and metastatic. If the tumor stays in pancreas and not spread to other organs it is said to be primary tumor. Tumors in pancreas may spread to the neighbouring organs and such tumors are metastatic tumors[5].

Diagnosis of pancreatic tumor is very difficult since it is located between many organs. Hence some diagnosis method involves CT scan, MRI scan, Ultrasound method, ERCP, biopsy, etc...[6].But here MRI images are chosen since it is free from radiations and also a non-invasive method and is always safe to check the tumor growth frequently for the physicists for further treatment. Tumors have an unique and different shapes so it is very difficult to get the exact

boundary and the accurate 3D image of the tumor. Though MRCP gives a 3D image of tumor in pancreas segmentation and interventions cannot be possible [7]. Hence an advanced software called 3D Doctor is used for 3D image processing, modelling of any image format which converts 2D image into a 3D image [8]. Manual segmentation process consume more time and are prone to errors and hence automatic segmentation can be done by 3D image segmentation. Before segmentation, the Region of Interest is defined on the image so as to limit the area to be processed by the image segmentation process [9]. This segmentation process can also be done by latest technique of 3D morphological filtering or image processing [10].

A part from the introduction the detailed methology of the process along with the architecture is drawn for easy understanding of the paper. Here we present an efficient way of dealing with the pancreatic tumor segmentation by overcoming the difficulties in MRCP mentioned above. The first section deals with the architecture overview and the next section deals with the methodology of the process. Then the results of the method along with image is displayed below and finally the conclusion. The figure a) gives the position of the pancreas between many complex vital organs. The most common pancreatic cancer is adenocarcinoma. Some of the organs are mentioned below,

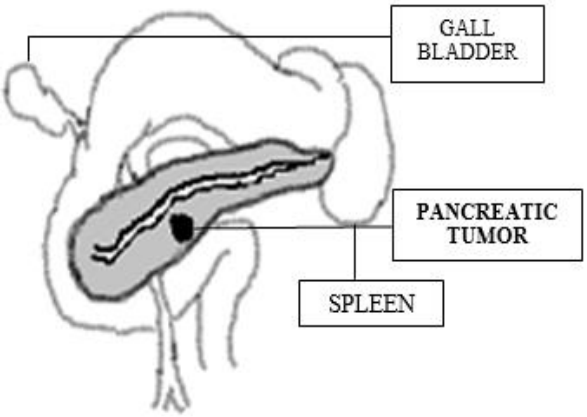

Figure a)

II. ARCHITECTURE OVERVIEW

The architecture overview gives an idea about the entire procedure of this proposed system. Thus the figure b) consists of four blocks each with their specific functions. In the first block the entire 2D processing of the MRI image and enhancement of the image process is described and output of the block goes into the next block where the tumor is detected using non-invasive optical spectroscopy in effective manner. The next is the important process of conversion of 2D MRI image into a 3D model using 3D Doctor software. The segmentation of tumor in the 3D model is described in the last block by various methods. Then finally the volume rendering is done and the final product will give the desired output of this process. The architecture is drawn below,

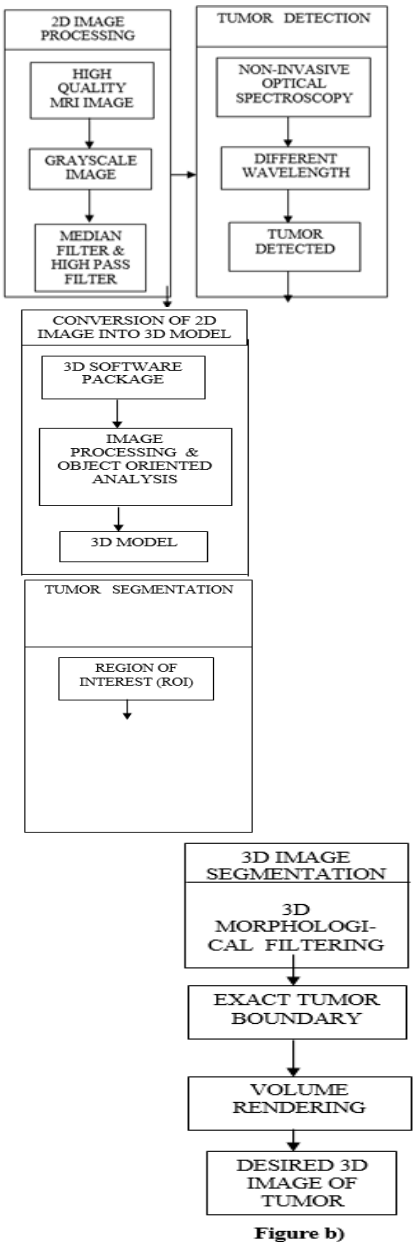

Figure b)

III. METHOLOGY

A flowchart has been designed for demonstrating the entire procedure of this work that is represented in figure c). This section is classified into two and the section A) deals how

the 2D MRI images are processed, enhanced and classified. The section B) discuss about the conversion of 2D into 3D images, segmentation of tumors and volume rendering.

SECTION 1:

A. Processing of 2D MRI image

Magnetic resonance imaging is a technique which is used to investigate the anatomy of human body by developing an image. MRI uses magnetism and radio waves for developing the image. MRI scanning is used here as it does not uses ionising radiations unlike CT which would affect the healthy tissues. Using high quality MRI scanners desired high quality images are obtained. These MRI images are needed to be converted into grayscale images. In color images, each colors have their respective and different intensities for each pixels. Grayscale does not have any RGB colors and have only grayshades [11]. The only color which have equal intensity is gray among RGB and hence it is easy to process grayscale images rather than color images which will be complex. If the entire light is transmitted it will be in white shade and if the total light is not transmitted it will be in black shade. Hence because of the above reasons, we convert obtained image into grayscale images.

B. Enhancing the image

The MRI image may be of lesser clarity and may also contains noise. In order to improvise the clarity by sharpening the image and to remove noise and other disturbances we use filtering techniques. The filtering techniques used here are high pass filter and median filter[12]. High pass filter allows only the image with high frequencies and filters the low frequencies. Hence the image gets sharpened and brightness is increased. Noise can be removed by using median filter without affecting the sharpness of the image by smoothening the image. Median filter calculates the median value of the output pixel with the help of the neighbouring pixels.

C. Tissue differentiation

In order to distinguish the tumors from the healthy tissues, we use tissue classification method. For pancreas, optical spectroscopy is an efficient way of identifying the abnormal tissues. Optical spectroscopy is the study which determine how objects emits and interacts with light. The composition of the object can be determined by the wavelength of the photons emitted by that object. Tumorous tissues will emit the photon of different wavelength when compared to the normal tissues. By analyzing the output of the spectroscopy the presence of tumor can be detected. If the output remains the same without any abnormal wavelength, then no tumor is detected and the pancreas remains healthy. Here non-invasive optical spectroscopy is used and hence it does not produces any infections like bleeding, sepsis, etc. [13].

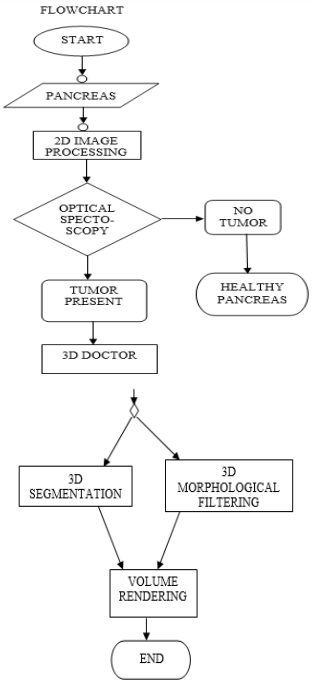

Figure c)

SECTION 2:

The main reason for this work is to create a 3D model from the 2D image slice and also to segment the tumor from the pancreas and to create volume rendering.

D. 3D Doctor software:

The 2D image is converted into 3D by 3D software package. It is very simple to use, the software has to be installed on the PC and then the 2D image file format is selected. The minimum system requirements for this software are an operating system, CPU, RAM with atleast 128MB or more and hard disk of 50 MB is generally needed and also a 16 bit color display or more with OpenGL support [9]. This software is now used in popular hospitals and research centres. Here the obtained 2D MRI image of the pancreas is processed by 3D Doctor and a 3D model of the image is obtained along with the tumor. It is easy to identify the location of the

tumor in 3D image. It is one of the leading software that is used mainly for doctors and surgeons

E. Region of interest (ROI)

The Region Of Interest (ROI) is generally defined in the 3D image such that it will reduce the area that is to be processed by the next image segmentation process. ROI is defined in the image by region of interest command or by edit. ROI can be marked in various shapes or by combination of shapes either polygon, circle or rectangle. Here the tumor region is marked as the region of interest and hence it eliminates other normal/healthy regions of the pancreas. 3D Image segmentation process is done after ROI because it will reduce the complexity in tumor segmentation. The ROI concept is to mark the tumor regions in polygon shapes which is commonly used or even other shapes. Hence a part of the region is marked as our region of interest.

F. 3D Image segmentation or Morphological filtering

Image segmentation process is done to get the boundary of the desired object. It uses the grayscale image range to get the boundaries. From the ROI region the exact boundary of the tumor is extracted by 3D image segmentation along with the tumor growing area. Here many objects are supported and hence we can get boundaries of more than one object/tumors. In hospitals segmentation is usually done manually and this process is time consuming and may be inaccurate and are prone to errors. Hence this automatic segmentation will be preferred by doctors. In pancreas the tumor can be found in three regions at various places. They are head, body and tail, however tumor found in head regions seems to be more complicated. Morphological filtering is generally done for 2D images but nowadays a new technique of 3D morphological filtering has been introduced. This method can also be used to get the exact tumor boundary or segmentation.

G. Volume rendering

Volume rendering is used to create a 3D display of both 3D images and along with the tumor boundary. It is used for three dimensional view of the respective data. The tumor can be visualized by using the ray tracing algorithm which is implemented in 3D Doctor software [9]. This technique will give the accurate size and all the faces of the tumor which is used to get the exact shape of the tumor. These volumetric tumors preserve the original gray level values of the tumors. These images may be a grayscale image or even a color image. And hence the pancreatic tumors affected range can be viewed clearly which can be used in further treatment and surgery.

IV. RESULT.

Thus the results of the entire process of image processing and its conversion from 2D image to 3D model and the segmentation of tumor from the pancreas can be shown as follows. The figure a) shows the 3D image of the pancreas along with the tumor and the figure b) shows the final output, the volume rendering of the tumor.

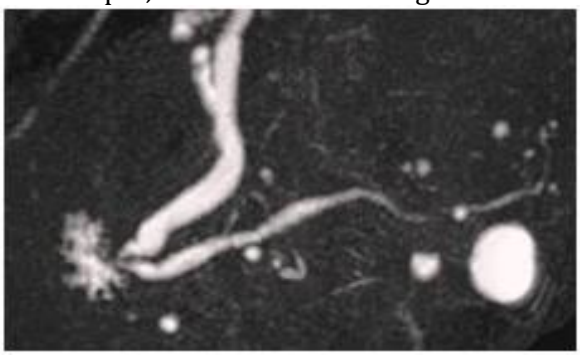

Figure d)

Figure e)

V.CONCLUSION

An effective method for detection and segmentation of tumor is presented in the above process. This method overcomes the disadvantages in MRCP where intervention and the segmentation of the tumor in 3D image in complex pancreas is made possible and the diagnosis of tumor is very risk and sensitive. The accurate boundary of tumor and volume rendering can be obtained whereas the manual segmentation consumes more time and may even prone to errors. It is more effective method

to detect and segment tumors in non-invasive and safe method without any radiation. It may also gives the 3D visualization of the pancreas along with the tumor segmentation. The above mentioned process can be implemented to any organs where tumor detection and segmentation is complicated.

REFERENCES

2009, California Pacific Medical Center, TRANLIV – PancreasCancer-prof-2009, see www.cpmc.org/liver

Arokia Priyanka Vaz, Moorthy P.Ponnusamy, Pathasarathy Seshacharyulu, and Surinder K. Batra, "A concise review on the current understanding of pancreatic cancer stem cells,'' Department of Biochemistry and Molecular Biology, Journal of Cancer Stem Cell Research(2014),ISSN 2329-5872.

Emanuele Dabizzi, Mauricio Saab Assef and Massino Raimondo, "Diagnostic Management of Pancreatic Cancer," Cancers 2011, pp.404-509, ISSN 2072-6694.

Kamal Kant Hiran, Ruchi Doshi, "An Artificial Neural Approach for Brain Tumor Detection Using Digital Image Segmentation, International Journal of Emerging Trends & Technology in Computer Science(IJETTCS),Volume 2, Issue 5, September-October 2013,ISSN 2278- 6856.

Marshall S. Baker, Nicholas J.Zyromski, "Proceedings of the 48th Annual Pancreas Club Meeting," J Gastrointest Surg (2014) 18:1385-1390 DOI 10.1007/s11605-014-2554-9.

American Cancer Society, Radiographic Studies at www.cancer.org published on 2013.

Kavita Gulati, Onofrio A Catalano, Dushyant V Sahani, "Advances in magnetic resonance cholangiopancreatography: From morphology to functional imaging,'' Indian J Radiol Imaging/Vol 17/Issue 4/November 2007

3D-DOCTOR, Advanced Imaging, June 1998, see www.3d-doctor.com

3D-DOCTOR User's Manual, 3D Imaging, Modelling and Measurement (2012), see http://www.ablesw.com

P. Maragos, "Morphological Filtering for Image Enhancement and Feature Detection,'' November 2004.

N. Gopinath, "Extraction of Cancer Cells from MRI Prostate Image Using MATLAB,'' International Journal of Engineering Science and Innovative Technology(IJESIT),Volume 1, September 2012,ISSN 2319-5967.

Yao Wang, "Median Filtering and Morphological Filtering,''EL5123-Image Processing.

Malavika Chandra, James Scheiman, Diane Simeone, Barbara McKenna, Julianne Purdy and Mary-Ann Mycek, "Spectral areas and ratios classifier algorithm for pancreatic tissue classification using optical spectroscopy,'' Journal of Biomedical Optics(2010).