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Morphological Image Processing Approach for 2D to 3D Reconstruction of MRI Brain Tumor from MRI Images

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Abstract:
The 2D Image Data to visualize in the MRI images which never give the actual feel of how the internal parts would exactly look like. This project presents method for 3D image reconstruction, which is one of the most attractive avenues in Computed tomography (CT) and Magnetic Resonance Imaging (MRI) are modern and valuable diagnostic methods in a wide range of medical applications. Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. In this paper brain tumor segmentation method has been developed and validated segmentation on 2 MRI Data. In this study, after a manual segmentation procedure the tumor identification, the investigations has been made for the potential use of MRI data for improving brain tumor shape approximation and 2D & 3D visualization for surgical planning and assessing tumor. Surgical planning now uses both 2D & 3D models that integrate data from multiple imaging modalities, each highlighting one or more aspects of morphology or functions. Finally, work was carried over to calculate the area of the tumor of single slice of MRI data set and then it was extended to calculate the volume of the tumor from multiple image MRI data sets. Experimental results show that method produces satisfactory output.

Key words*: Brain tumor segmentation, MRI, Morphological Operation, Volume Visualization*

1. Introduction

The extraction of 3D objects and its visualization is one of the most important steps in the analysis of the pre processed medical image data, which can help in performing diagnosis, treatment planning, and treatment delivery. Thus in practice, radiation oncologists spend a substantial portion of their time performing the segmentation task manually, using one of the available visualization and segmentation tools [1]. Also, there may be cases where the automatic methods fail or perform poorly. Another consideration is that medical doctors must always have final control over the segmentation [2]. The most common primary brain Tumors are gliomas, wherein 70% are in the group of malignant gliomas (anaplastic astrocytoma World Health Organization (WHO) grade III), glioblastoma multiform (GBM) WHO grade IV) [3]. The GBM is one of the highest malignant human neoplasms. Due to the biological behaviour, gliomas of WHO grade II to IV cannot be cured with surgery alone. The multimodal the rapeutical concept involves maximum safe resection followed by radiation and chemotherapy, depending on the patient's functional impairment scale. The survival rate is still only approximately 15 months, despite new technical and medical accomplishments such as multimodal navigation during micro-surgery, stereotactic radiation or the implementation of alkylating substances [4]. The clinical follow-up of tumor volume is essential for an adaptation of the therapeutically concept. Therefore, the exact volume evaluation is fundamental to reveal a recurrent tumor or tumor progress as early as possible. 3D Magnetic Resonance Imaging (MRI) uses few hundred megahertz radio frequency to disturb polarized hydrogen spin so that it returns back to un polarized state in certain relaxation time. The relaxation time is influenced by hydrogen structure and bounding which can differentiate between types of material. In the recent years, 3D MRI has become the best non ionizing medical imaging modality, due to its excellent resolution and contrast for both soft and hard tissue. Current research in this modality is trying to improve coil sensitivity, use higher tesla and find algorithms for faster 3D visualization. The application of MRI is not only in medicine but a lso for industrial and material testing. For the past few decades, MRI has also been used to characterize material. Apart from its excellent image quality, MRI has limitations when interacting with metal. This problem remains to be unsolved for the foreseeable future.

2. Problem Definitions

As there is a rapid growth in field of medical in past few years, the availability of the digital data such has brain images, to the public has increased. The problem of protecting and medical information has become more and more difficult and important too. It is very important to know the exact problem of the brain. Of the many approaches possible to identify the problem, but using morphological image processing techniques with representation of 2D TO 3D will give the accurate result. more efficient and

successful method is required for to identify problem. This project proposes a morphological image processing approach for 2D TO 3D reconstruction of MRI brain tumor from MRI images.
Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. Here, a brain tumor segmentation method has been developed and validated segmentation on 2D MRI Data. In this study, after a manual segmentation procedure the tumor identification, the investigations has been made for the potential use of MRI data for improving brain tumor shape approximation and 2D and 3D visualization for surgical planning and assessing tumor. Surgical planning now uses both 2D and 3D models that integrate data from multiple imaging modalities, each highlighting one or more aspects of morphology or functions. Firstly, the work was carried over to calculate the area of the tumor of single slice of MRI data set and then it was extended to calculate the volume of the tumor from multiple image MRI data sets.

3. Related Work
Despite active research in the field, A number of schemes have been devised for combining field gradients and radio frequency excitation to create an image: 2D or 3D reconstruction from projections, much as in computed tomography. Building the image point-by-point or line-by-line. Gradients in the RF field rather than the static field. Although each of these schemes is occasionally used in specialist applications, the majority of MR Images today is created either by the two-dimensional Fourier transform (2DFT) technique with slice selection, or by the three-dimensional Fourier transforms (3DFT) technique. Another name for 2DFT is spin-warp. What follows here is a description of the 2DFT technique with slice selection. The 3DFT technique is rather similar except that there is no slice selection and phaseen coding is performed in two separate directions. Another scheme which is sometimes used, especially in brain scanning or where images are needed very rapidly is called echo-planar imaging (EPI): In this case, each RF excitation is followed by a train of gradient echoes with different spatial encoding.

3.1. Objectives
- Collecting the medical images from a modality.
- To develop an effective algorithm for medical image segmentation.
- Applying required morphological image processing techniques
- To develop an effective algorithm for getting 3D Representation From 2D Slices.
- Calculate the Volume of the tumor.

4. Proposed Methodology
The flow chart for entire procedure of this work is shown in Figure 1. The method involved mainly two parts. The First part is automatic segmentation of tumor from the acquired slices having presence of tumor, in an MRI dataset. The second part involved stacking 2D slices of segmented tumor and perform volumetric rendering using MATLAB tool kit.

4.1. Image Acquisition
In this work, MRI images were collected; The images were gray scale images. Axial slices of T2 weighted and T1 FLAIR brain MRI data were considered. In this method, segmentation of Regions of Interest (ROI) was calculated on ten MR image data sets with each set containing 20 slices. For 3D rendering operation, only slices which contain tumor portions are considered. Image database development and validation of the algorithms were based on this MRI database which was already manually identified and segmented by the Radiologist. The selected images were histopathologically tested and have confirmed the presence of the disease. The Entire procedure was done using MATLAB and verification of 3D rendered data we used a software package called 3D DOCTOR that is usually used by Radiologists.

4.2. Image Segmentation of Tumor and 3D Rendering
The goal of this work is to extract the tumor and to create 3D models and volume rendering from 2D slice images. T1 FLAIR and T2 weighted images of the same slice used for glioma tumor extraction are given in **figure 5.4.** As a part of pre-processing, skull stripping was performed. Skull stripping is a method of removing the skull and non-brain intracranial tissues like fat, muscle, skin etc., that surround the surface of brain cortex and cerebellum in the brain. Brain Extraction was necessary to avoid the misclassifications of the surrounding tissues, skin and scalp as WM or GM. By removing this object, non-brain tissues will be removed and, only soft tissues will remain in the image. Skull stripping was based the on morphological operation known as erosion, using a disc shaped structuring element, which resulted in the removal of thin connections between the brain and non-brain portions. Thus a skull stripped brain mask was obtained and this method was automated for every image slice. The 2D segmented slices are stacked before performing rendering operation. In an image data set, out of the twenty two slices only seven or eight slices are useful for segmentation. The main steps to create 3D models and volume rendering from 2D slice images:
- Create an empty space for 3D volume.
- Each image pixel's x and y coordinate on 2D will be transferred to the empty space. The slice number with respect to the distance between each slice is taken as z coordinate. If a pixel is adjacent to another pixel, the 3D points will be connected together.
- Repeat the previous 2 steps until all slices are done. All the points in the 3D space will be Connected just like in the 2D slices.
- 3D volume rendering.

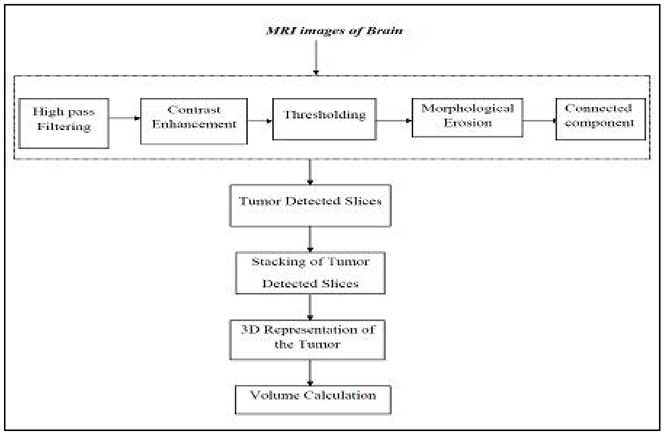
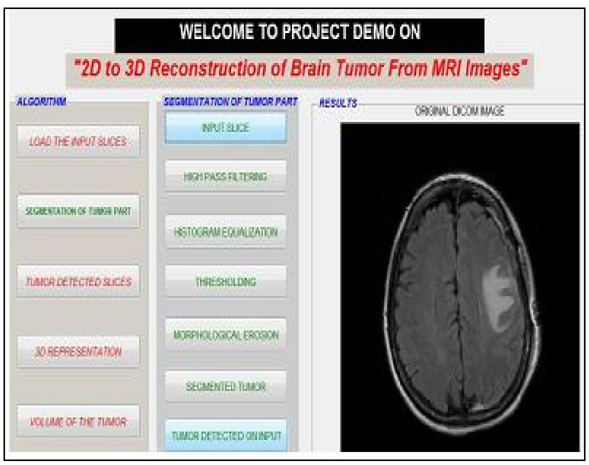


Figure 1: The flow chart for segmentation of volumetric 3D tumor.

For the correct rendering of stacked image slices, since all 2D images are of the same dimension, Hence the 3D volume can hold all of them in a rectangular cube. Different degrees of interactive Control are provided for 3D tools in MATLAB, for the semiautomatic 3D propagation and rendering. In this way, we can perform a hierarchical volume rendering of the segmented slices. 3D medical imaging software called 3D DOCTOR is used for verification of volume rendered Tumor. This package was developed using object oriented technology and provides efficient tools to process and analyse 3D images, object boundaries, 3D models and other associated data items in an easy to use environment.

5 Results



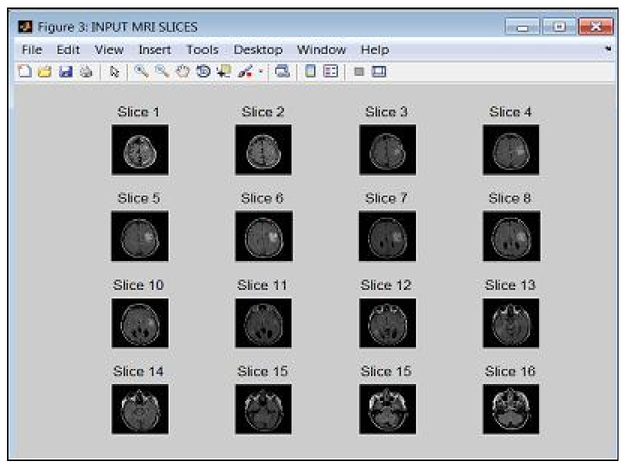
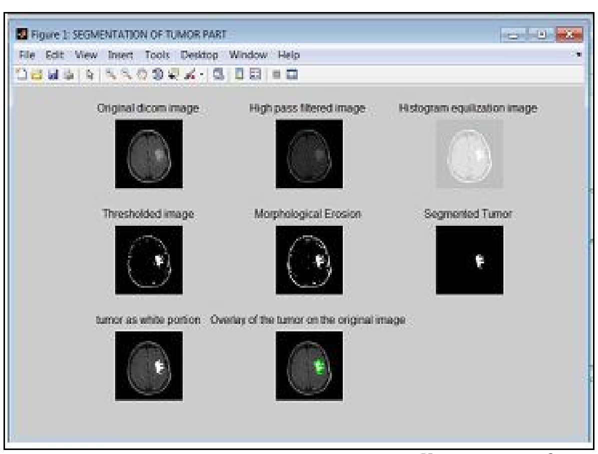


Figure 2: GUI of proposed work

Figure 3: Illustration of multiple image view option



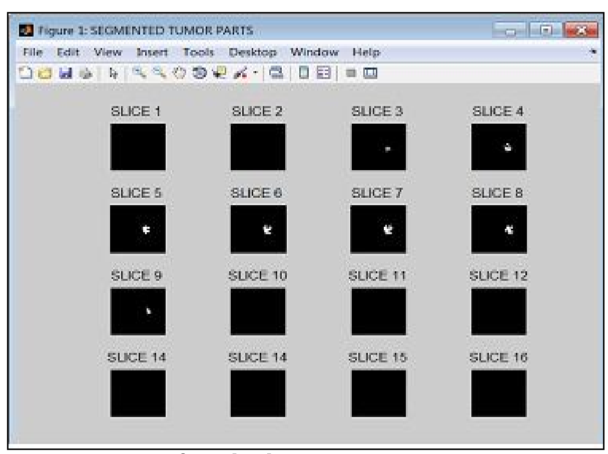


Figure 4: Illustration of Segmenting process of single slice

Figure 5: Illustration of binary image view of the extracted tumor slices.

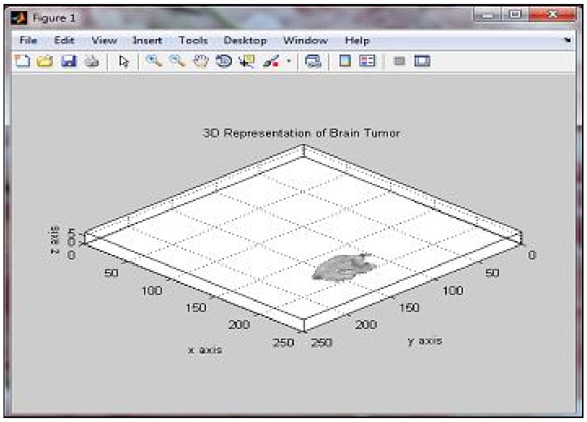
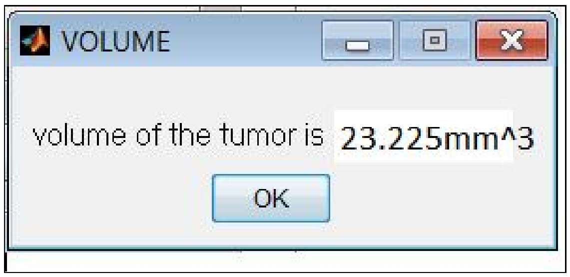


Figure 6. 3D view of tumor



TEST UNIT NO 1: VOLUME OF TUMOR(CC), VOLUME = 22.725.
TESTRESULT: GOOD

6. Conclusion

In this work user friendly software for processing the MRI image slices for the reconstruction of Tumors was developed. The software was tested and calibrated using real MRI data. In the application of the software the real data was enhanced and the tumor was extracted from the images in a user friendly way. The 2D extracted tumor images were reconstructed into 3D volumetric data and the volume of the tumor was also calculated. In the execution of the software more time has been taken in the cubic interpolation segment which was used in 3D reconstruction. The Matlab platform with its many wonderful functions has helped in achieving the target of extraction and reconstruction of the tumor from the real data. Application of the software has given fair results in terms of volume reconstruction of Tumors. However, in some cases when tumor contrast was relatively poor, or the image pixel values of the tumor region were very different from their expected values, software could not reconstruct the volume with good reproducibility. This further shows the importance of acquiring the high quality MRI scans with sufficiently good resolution and contrast for automated volume measurement and display using the present software. The efficiency of the proposed 3D MRI data visualization software was verified using the MRI images of brain tumor.

7 Future Work

Further implementation of this software in various other parts the body like throat, pelvic and lung for understanding cancer, heart diseases. We also have to work on optimizing, in terms of speed of the algorithm for processing larger images.

8. References

1. K Narayanan , Yogesh Karunakar, “3-D Reconstruction of Tumors in MRI Images”,International Journal of Research and Reviews in Signal Acquisition and Processing (IJRRWSAP) Vol. 1, No. 2, June 2011 ISSN: 2046-617X Copyright © Science Academy Publisher, United Kingdom.www.sciacademypublisher.com.
2. S. Ananda Resmi, Tessamma Thomas, “ A semiautomaticmethod for segmentation and 3D modeling of glioma tumors from brain MRI”, J. Biomedical Science and Engineering, 2012, 5, 378-383 doi:10.4236/jbise.2012.57048 Published Online July 2012.
3. Panos D. Kotasa,Tony Dodd, “A Review of Methods for 2D/3D Registration ”,World Academy of Science ,Engineering and Technology 59 2011.
4. Rajesh C.Patil , A S Bhalchandra, “Brain Tumor Extraction From MRI Images using MATLAB”, International Journal of Electronics Communication & soft computing science and engineering ,ISSN:2277-9477,Volume2,Issue1.
5. Jan Barabas, Branko Babusiak, Michal Gala,Roman Radil , Martin Capka , “Analysis, 3D reconstruction and anatomical feature extraction from medical images”2012 International Conference on Biomedical Engineering and Biotechnology, , DOI 10.1109/iCBEB.2012.72.
6. Aidong Zhang, Ju Li, Lingxia Sun, Ying Zhou, “Three-dimensional Reconstruction of SerialIndustrial Computed Tomography Images”18th World Conference on Nondestructive Testing, 16-20 April 2012, Durban, South Africa.

7. Eko Supriyanto**,** “3-D Imaging Models:Technology and Application**”,** Clinical Science and Engineering Department Faculty of Health Science and Biomedical Engineering Universiti Teknologi Malaysia.
8. Jeffrey A. Fessler, “ Model-based image reconstruction for MRI”, Supported in part by NIH grants CA87634 and NS058576
9. Vladmir A Knyaz, Sergey Yu. Zheltor, “Vision Based Technique for Photorealistic 3D Reconstruction of Historical Items”, GIS development .net
10. **S**. Cocitoa,, S. Sgorbinia, A. Peiranoa, M. Valleb., “ 3-D reconstruction of biological objects using underwater video technique and image processing”, Journal of Experimental Marine Biology and Ecology 297 (2003) 57– 70.
11. D.W. McRobbie, E. A. Moore, M. J. Graves, M. R. Prince. MRI – From Picture to Proton(2003).Cambridge University Press.
12. Lorena Tonarelli, “ Magnetic Resonance Imaging of Brain Tumor”, Enterprises for Continuing Education, Inc.PO Box 300,Brighton, MI 48116- 0300,www.cewebsource.com.
13. G.E. Christensen, S.C. Joshi and M.I. Miller, “Volumetric transformation of brain anatomy”, IEEE Transaction of Medical Imaging, pp. 864-877, 1997
14. Jain, Anil K., “Fundamentals of Digital Image Processing”, Prentice Hall, Englewood Cliffs, NJ, 1989