Analysis of Different Brain Tumor Detection and Segmentation Techniques in MRI and other Medical Images

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Abstract
Brain is that the anterior most a part of the central nervous system. Tumor is caused because of formation of additional cells in brain as a result of new cells build up whereas existences of older or broken cells for an unknown reason. Today's recent medical imaging analysis faces the challenge of detective work tumor through magnetic resonance pictures (MRI). Broadly, to provide pictures of sentimental tissue of body, MRI pictures are used by specialists. For tumor detection, image segmentation is needed. Physical segmentation of medical image by the radiotherapist may be a monotonous and prolonged method. Imaging may be an extremely developed medical imaging methodology providing made info concerning the person soft-tissue structure. There are varied tumor recognition and section strategies to find and segment a tumor from imaging pictures. A range of algorithms were developed for segmentation of magnetic resonance imaging images by exploitation completely different tools and methods. Instead this paper presents a comprehensive review of the ways and techniques accustomed find tumor through imaging image.

Keywords
Brain Tumor, Magnetic Resonance Image (MRI), Segmentation, Clustering

I. Introduction

The MRI scan is more leisurely than CT scan for diagnosis. it is not affect the human body. Because it does not use any radiation. It's based on the magnetic field and radio waves. There are differing kinds of algorithm were developed for brain tumor detection. However they will have some disadvantage in detection and extraction. During this project, two algorithms are used for segmentation. Therefore it provides the accurate result for tumor segmentation. Tumor is due to the uncontrolled growth of the tissues in any part of the body. The tumor may be primary or secondary. If it's an origin, then it's referred to as primary. If the part of the tumor is spread to another place and grown as its own then it's referred to as secondary. Usually brain tumor affects CSF (Cerebral Spinal Fluid). It causes for strokes. The physician provides the treatment for the strokes instead of the treatment for tumor. Therefore detection of tumor is very important for that treatment. The lifetime of the person who affected by the brain tumor can increase if it's detected at current stage. That will increase the lifetime about 1 to 2 years.

B. Operations Types of Tumor

In medical imaging, 3D segmentation of images plays a significant role in stages that occur before implementing object recognition. 3D image segmentation helps in automatic diagnosis of brain diseases and helps in qualitative and menstruation of images like measuring accurate size and volume of detected portion. Accurate measurements in brain diagnosis are quite difficult because of numerous shapes, sizes and appearances of tumors. Tumors will grow abruptly causing defects in neighboring tissues conjointly, which provides an overall abnormal structure for healthy tissues as well. We will develop a method of 3D segmentation of a brain tumor by using segmentation in conjunction with morphological operations [1].

B. Tumor

The word tumor is a synonym for a word neoplasm that is created by an abnormal growth of cells tumor is something totally different from cancer.

C. Types of Tumor

There are three common forms of tumor: (1) Benign (2) Pre-Malignant (3) Malignant (cancer will solely be malignant) [1]) Benign Tumor: A benign tumor is a tumor is that the one that doesn't expand in an abrupt way; it doesn't affect its neighboring healthy tissues and also doesn't expand to non-adjacent tissues. Moles are the common example of benign tumors. (2) Pre-Malignant tumor: Premalignant Tumor may be a precancerous stage, considered as a disease, if not properly treated it may result in cancer. (3) Malignant Tumor: Malignancy (mal- = "bad" and ignis = "fire") is the form of tumor, that grows worse with the passage of time and ultimately results in the death of a person. Malignant is essentially a medical term that describes a severe progressing disease. Malignant tumor is a term that is usually used for the description of cancer [21].

II. Medical Imaging Techniques

Brain tumors represent a novel challenge in this they affect the organ that's the essence of the "self." moreover, because every area of the brain serves a distinct but important function, the therapy that's most effective for other cancers—surgical removal of either the whole organ or the tumor with a generous surround of normal tissue—cannot be used to cure brain tumors. Unfortunately, most brain tumors are relatively insensitive to other cancer treatment, including radiation and chemotherapy. Coupled with the problem in treating brain tumors is the unique biology of the brain.

A. MRI

Magnetic Resonance Imaging (MRI), Nuclear Magnetic Resonance Imaging (NMRI), or Magnetic Resonance Tomography (MRT) is a medical imaging technique utilized in radiology to examine detailed internal structures. MRI makes use of the property of Nuclear Magnetic Resonance (NMR) to image nuclei of atoms inside the body.

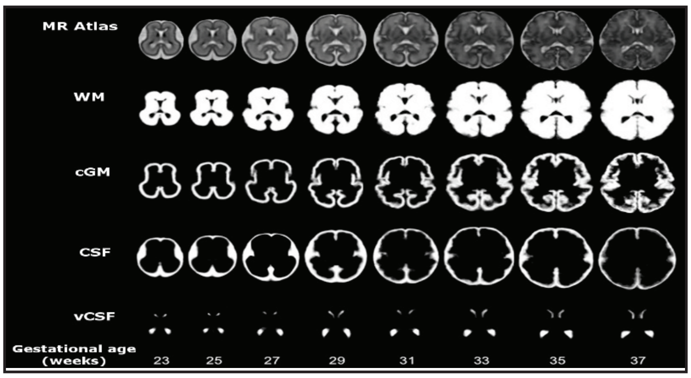

Fig. 1: Data Set of MRI Image

B. CT Scan

A CT scan stands for computed tomography scan. It's conjointly referred to as a CAT (Computer Axial Tomography) scans. It's a medical imaging methodology that employs tomography. Tomography is the method of generating a two-dimensional image of a slice or section through a 3-dimensional object (a tomogram).

Interest in computed tomography comes from the fact that, contrary to nuclear medicine strategies, it's widely accessible and offers high spatial resolution images with fast acquisition modes: a slice can be acquired in less than a second, with common spatial resolution of regarding 1 mm. Most CT equipment consists of an x-ray tube and a precise number of detecting components rotating together around the patient, at the same time as the patient table advances though the detection ring, which provides a "spiral" or "helicoidal" acquisition. Contrast in CT images arises from interactions of X-rays with tissues. There are different types of interaction, the principal one being the photoelectric impact.

III. Methods of MRI Images Segmentations

It begins with a model that grows, updated accordingly to the image characteristics of the image. Within this group, they stand out:

A. Segmentation Methods

Several common approaches have appeared within the recent literature on medical image segmentation. we outline each methodology, provide an outline of its implementation, and discuss its benefits and disadvantages. Though every technique is described individually, multiple techniques are typically utilized in conjunction for solving different segmentation issues. We divide segmentation strategies into eight categories.

B. Thresholding Technique

Thresholding approaches segment scalar images by creating a binary partitioning of the image intensities. The histogram of a scalar image that possesses totally different apparent classes, like the various modes. A thresholding procedure attempts to determine an intensity worth, referred to as the threshold, that separates the desired classes. The segmentation is then achieved by grouping all pixels with intensities larger than the threshold into one class and all alternative pixels into another class. Determination of more than one threshold worth is a method referred to as multi-thresholding. Thresholding could be a simple however often effective means that for obtaining a segmentation of images in which totally different structures have contrasting intensities or other quantifiable features.

Its main limitations are that, in its simplest form, solely two classes are generated, and it can't be applied to multichannel images. in addition, thresholding typically doesn't take into account the spatial characteristics of an image. This causes it to be sensitive to noise and intensity in homogeneities, which can occur in MR Images. Each of these artifacts primarily corrupts the histogram of the image, making separation more difficult. For these reasons, variations on classical thresholding are projected for medical-image segmentation that incorporate information based on native intensities and connectivity.

C. Region Based Method – Growth of Regions

The first region growing methodology was the seeded region growing methodology. This methodology takes a set of seeds as input along with the image. The seeds mark every of the objects to be segmented. The regions are iteratively grown by comparing all unallocated neighboring pixels to the regions. The difference between a pixel's intensity worth and also the region's mean, δ, is employed as a measure of similarity. The pixel with the smallest difference measured this way is allotted to the various regions. This method continues until all pixels are allotted to a region. The growth of the regions is carried out from the seeds that were determined as input, wherever each one of them contains the following information:

- **Position:** These are x, y and z coordinates within the image. It's known that this point belongs to the region of interest.
- **Intensity:** The voxel intensity is vital to determine the rank of intensities that may be included in the region (if the inclusion criterion makes use of this value).

D. Clustering

Clustering algorithms primarily perform an equivalent function as classifier strategies without the utilization of training data. Thus, they are termed unsupervised strategies. To compensate for the lack of training data, clustering strategies iteratively alternate between segmenting the image and characterizing the properties of every category. In a sense, clustering strategies train themselves, utilizing the accessible data. Three commonly used clustering algorithms are the –

- K-means or ISODATA algorithm,
- The fuzzy c-means algorithm,
- Expectation-maximization (EM) algorithm.

IV. Review of Different Methods

In the last decade there are different methods are coming in the field of brain tumor detection and segmentation. In the section few of them are summarized. They are based on different type brain tumor techniques.

J. selvakumar, A.Lakshmi, T.Arivoli,"Brain Tumor Segmentation and Its Area Calculation in Brain MR Images are using K-Mean Clustering and Fuzzy C-Mean Algorithm" [1].

This paper deals with the implementation of simple algorithm for detection of range and shape of tumor in brain Mr Images. Tumor is an uncontrolled growth of tissues in any a part of the body. Tumors are totally different types and they have different Characteristics and different treatment. as it is known, brain tumor is inherently serious and life-threatening because of its character within the restricted space of the intracranial cavity (space formed inside the skull). Most analysis in developed countries shows that the numbers of people who have brain tumors were died due to the fact of inaccurate detection. Generally, CT scan or MRI that's directed into intracranial cavity produces an entire image of brain. This image is visually examined by the physician for detection & diagnosis of brain tumor. But this methodology of detection resists the accurate determination of stage & size of tumor. To avoid that, this project uses computer aided methodology for segmentation of brain tumor based on the combination of two algorithms. This methodology allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduces the time for analysis. At the end of the process the tumor is extracted from the Mr image and its precise position and shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster.

B. Phooi Yee Lau, Frank C. T. Voon, Shinji Ozawa,"The detection and visualization of brain tumors on T2-weighted MRI images using multiparameter feature blocks" [2].

The objective of this paper is to present an analytical methodology to detect lesions or tumors in digitized medical images for 3D visualization. The authors developed a tumor detection methodology using three parameters; edge (E), gray (G), and contrast (H) values. The strategy projected here studied the EGH parameters in a supervised block of input images. These feature blocks were compared with standardized parameters (derived from normal template block) to detect abnormal occurrences, e.g. image block that contain lesions or tumor cells. The abnormal blocks were transformed into three-dimension space for visualization and studies of robustness. Experiments were performed on completely different brain disease based on single and multiple slices of the MRI dataset. The experiments results have illustrated that our proposed conceptually simple technique is able to effectively discover tumor blocks whereas being computationally efficient. During this paper, authors introduced a prototype system to evaluate the performance of the planned strategies, comparison detection accuracy and robustness with 3D visualization.

C. Dipali M. Joshi, Dr. N. K. Rana and V. M. Mishra, "Classification of Brain Cancer Using Artificial Neural Network", [3].

A Brain Cancer Detection and classification system has been designed and developed. The system uses computer based procedures to observe tumor blocks or lesions and classify the kind of tumor using Artificial Neural Network in MRI images of various patients with Astrocytoma form of brain tumors. The image processing techniques like histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction are developed for detection of the brain tumor within the MRI images of the cancer affected patients. The extraction of texture features in the detected tumor has been achieved by using gray Level Co-occurrence Matrix (GLCM). These features are compared with the stored features within the knowledge base. Finally a Neuro Fuzzy Classifier has been developed to recognize differing types of brain cancers. The entire system has been tested in two phase's firstly Learning/Training phase and secondly Recognition/Testing phase. The known MRI images of affected brain cancer patients obtained from Radiology Department of Tata Memorial Hospital (TMH) were used to train the system. The unknown samples of brain cancer affected MRI images are obtained from TMH and were used to test the system. The system was found efficient in classification of these samples and responds any abnormality.

D. Carlos Arizmendi, Juan Hernández-Tamames, Enrique Romero, Alfredo Vellido, Francisco del Pozo, "Diagnosis of Brain Tumors from Magnetic Resonance Spectroscopy using Wavelets and Neural Networks" [4].

The diagnosis of human brain tumors from noninvasive signal measurements could be a sensitive task that needs specialized experience. During this task, radiology specialists are likely to benefit from the support of computer-based systems designed around robust classification processes. During this brief paper, a technique that combines data pre-processing using wavelets with classification using Artificial Neural Networks is shown to yield high diagnostic classification accuracy for a broad range of brain tumor pathologies.

E. Arpita Das, Mahua Bhattacharya, "A Study on Prognosis of Brain Tumors Using Fuzzy Logic and Genetic Algorithm Based Techniques" [5].

In present study attempt has been taken to determine the degree of malignancy of brain tumors using artificial intelligence. The suspicious regions in brain as recommended by the radiologists are segmented using fuzzy c-means clustering technique. Fourier descriptors are utilized for precise extraction of boundary features of the tumor region. As Fourier Descriptors introduce an outsized variety of feature vectors that will invite the problem of over learning and chance of misclassifications, the projected diagnosis system efficiently search the numerous boundary features by genetic algorithm and feed them to the adaptive neuro-fuzzy primarily based classifier. Additionally to shape based features, textural compositions are also incorporated to attain high level of accuracy in diagnosis of tumors. The study involves 100 brain images and has shown 86 correct classification rates.

F. Ahmed Kharrat, Mohamed Ben Messaoud, "Detection of Brain Tumor in Medical Images" [6].

This paper introduces an efficient detection of brain tumor from cerebral MRI images. The methodology consists of 3 steps: enhancement, segmentation and classification. To boost the standard of images and limit the risk of distinct regions fusion within the segmentation phase an enhancement method is applied. Authors adopt mathematical morphology to extend the contrast in magnetic resonance imaging images. Then authors apply wavelet transform within the segmentation method to decompose magnetic resonance imaging images. At last, the k-means algorithm is enforced to extract the suspicious regions or tumors. Some of experimental results on brain images show the feasibility and the performance of the projected approach.

G. Jason J. Coso, Eitan Sharon, ShishirDube, Usha Sinha, and Alan Yuille,"Efficient Multilevel Brain Tumor Segmentation with Integrated Bayesian Model Classification" [7].

Authors introduced a new methodology for automatic segmentation of heterogeneous image data that takes a step toward bridging the gap between bottom-up affinity-based segmentation strategies and top-down generative model based approaches. The main contribution of the paper is a Bayesian formulation for incorporating soft model assignments into the calculation of affinities, that are conventionally model free. Authors integrate the resulting model-aware affinities into the multilevel segmentation by weighted aggregation algorithm, and apply the technique to the task of detecting and segmenting brain tumor and edema in multichannel resonance (MR) volumes. The computationally efficient methodology runs orders of magnitude faster than current progressive techniques giving comparable or improved results. Our quantitative results indicate the advantage of incorporating model-aware affinities into the segmentation method for the difficult case of glioblastoma multiform brain.

VI. Conclusion

In this paper, we analyzed the various methodologies of brain tumor detection and segmentation. This analysis was conducted to observe brain tumor using medical imaging techniques. The main technique used was segmentation, which is done using a methodology based on threshold segmentation, watershed segmentation and morphological operators. The projected segmentation methodology was experimented with MRI scanned images of human brains: thus locating tumor in the images. Samples of human brains were taken, scanned using MRI method and then were processed through segmentation strategies thus giving efficient end results.

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