RESEARCH ARTICLE OPEN ACCESS

Bilateral Symmetry Information for Brain Tumor Detection

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Abstract
Image segmentation is used to separate an image into several “meaningful” parts. It is an old research topic, which started around 1970, but there is still no robust solution toward it. There are two main reasons; the first is that the content variety of images is too large, and the second one is that there is no benchmark standard to judge the performance. Various subjects that are paired usually are not identically the same, asymmetry is perfectly normal but sometimes asymmetry can benoticeable too much.
Structural and functional asymmetry in the human brain and nervous system is reviewed in a historical perspective. Brain asymmetry is one of such examples, which is a difference in size or shape, or both. Asymmetry analysis of brain has great importance because it is not only indicator for brain cancer but also predict future potential risk for the same. In our work, we have concentrated to segment the anatomical regions of brain, isolate the two halves of brain and to investigate each half for the presence of asymmetry of anatomical regions in MRI.
Keywords: MRI, Asymmetry Relation, Region of Interest

I. Introduction

Segmentation subdivides an image into its regions of components or objects and an important tool in medical image processing. As an initial step segmentation can be used for visualization and compression. Through identifying all pixels (for two dimensional image) or voxels (for three dimensional image) belonging to an object, segmentation of that particular object is achieved. In medical imaging, segmentation is vital for feature extraction, image measurements and image display [3]. Segmentation of the brain structure from MRI has received paramount importance as MRI distinguishes itself from other modalities and MRI can be applied in the volumetric analysis of brain tissues such as multiple sclerosis, schizophrenia, epilepsy, Parkinson’s disease, Alzheimer’s disease, cerebral atrophy, etc.

Other important aspect of the segmentation method is the color space from which color features are computed (for instance RGB space with Euclidean color distance). Each segmentation technique is usually based on some mathematical model (theory) and/or algorithmic approach (for instance fuzzy clustering, Markov random field, recursive procedure, bottom-up algorithm etc.). Most of segmentation techniques assume something about the scene which is seen in the image (for instance objects are polyhedral made of dielectric materials).This is an additional knowledge attribute of the given segmentation method [4].

Image segmentation is a process of pixel classification. An image is segmented into subsets by assigning individual pixels to classes. It is an important step towards pattern detection and recognition. Segmentation is one of the first steps in image analysis. It refers to the process of partitioning a digital image into multiple regions (sets of pixels). Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. The level of segmentation is decided by the particular characteristics of the problem being considered. Image segmentation could be further used for object matching between two images. An object of interest is specified in the first image by using the segmentation result of that image; then the specified object is matched in the second image by using the segmentation result of that image [5].

II. Literature Survey

As the first step in image analysis and pattern recognition, image segmentation is always a crucial component of most image analysis and pattern recognition systems, and determines the quality of the final result of analysis. So image segmentation has been intensively and extensively studied in the past years. And a wide variety of methods and algorithms are available to deal with the problem of segmentation of images. According to existing automatic image segmentation techniques can be classified into four categories, namely, (1) Clustering Methods, (2) Thresholding Methods, (3) Edge-Detection Methods, and (4) Region-Based Methods [6].

1. Clustering Methods

Clustering is a process whereby a data set (pixels) is replaced by cluster; pixels may belong together because of the same color, texture etc. There are two natural algorithms for clustering: divisive clustering and agglomerative clustering. The difficulty in using either of the methods directly is that there are lots of pixels in an image. Also, the methods are not explicit about the objective function that is being optimized. An alternative approach is to write down an objective function and then build an algorithm. The K-means algorithm is an iterative technique that is used to partition an image into K clusters, where each pixel in the image is assigned to the cluster that minimizes the variance between the pixel and the cluster center and is based on pixel color, intensity, texture, and location, or a weighted combination of these factors. This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set of clusters and the value of K [7].

2. Thresholding Methods

Thresholding is the operation of converting a multilevel image into a binary image i.e., it assigns the value of 0 (background) or 1 (objects or foreground) to each pixel of an image based on a comparison with some threshold value T (intensity or color value). When T is constant, the approach is called global thresholding; otherwise, it is called local thresholding. Global thresholding methods can fail when the background illumination is uneven. Multiple thresholds are used to compensate for uneven illumination. Threshold selection is typically done interactively.

3. Edge Detection Methods

Edge detection methods locate the pixels in the image that correspond to the edges of the objects seen in the image. The result is a binary image with the detected edge pixels. Common algorithms used are Sobel, Prewitt, Robert, Canny and Laplacian operators. These algorithms are suitable for images that are simple and noise free; and will often produce missing edges, or extra edges on complex and noisy images.

4. Region-Based Methods

The goal of region-based segmentation is to use image characteristics to map individual pixels in an input image to sets of pixels called regions that might correspond to an object or a meaningful part of one. The various techniques are: Local techniques, Global techniques and Splitting and merging techniques. The effectiveness of region growing algorithms depends on the application area and the input image. If the image is sufficiently simple, simple local techniques can be effective. However, on difficult scenes, even the most sophisticated techniques may not produce a satisfactory segmentation.

Edge-based techniques are based on the assumption that pixel values change rapidly at the edge between two regions Operators such as Sobel or Roberts operators can be used to detect the edges. And some post procedures such as edge tracking, gap filling can be used to generate closed curves. Region-based techniques are based on the assumption that adjacent pixels in the same region should be consistent in some properties. Namely, they may have similar characteristic such as grey value, color value or texture. The deformable models are based on curves or surfaces defined within an image that moves due to the influence of certain forces [8]. And the global optimization approaches use a global criterion when segmenting the image.

III. Problem Statement

Brain tumors are a heterogeneous group of central nervous system neoplasms that arise within or adjacent to the brain. Moreover, the location of the tumor within the brain has a profound effect on the patient's symptoms, surgical therapeutic options, and the likelihood of obtaining a definitive diagnosis. The location of the tumor in the brain also markedly alters the risk of neurological toxicities that alter the patient's quality of life.

At present, brain tumors are detected by imaging only after the onset of neurological symptoms. No early detection strategies are in use, even in individuals known to be at risk for specific types of brain tumors by virtue of their genetic makeup. Current histopathological classification systems, which are based on the tumor's presumed cell of origin, have been in place for nearly a century and were updated by the World Health Organization in 1999. Although satisfactory in many respects, they do not allow accurate prediction of tumorbehaviour in the individual patient, nor do they guide therapeutic decision-making as precisely as patients and physicians would hope and need. Current imaging techniques provide meticulous anatomical delineation and are the principal tools for establishing that neurological symptoms are the consequence of a brain tumor. There are many techniques for brain tumor detection. I have used edge detection technique for brain tumor detection.

IV. The Proposed Mechanism

4.1. Our algorithm

Our algorithm composes of two steps. The first is to define the bilateral symmetrical axis. The second is to detect the region of brain tumor.

4.1.1 Symmetry axis defining

The first step of our algorithm is mainly based on symmetry character of brain MRI.

If without tumor in the brain or the size of tumor is very small, the symmetry axis can be defined with a straight line $x = k,(y >= 0)$, which separates the image into two bilateral symmetry parts, show as Figure.2.

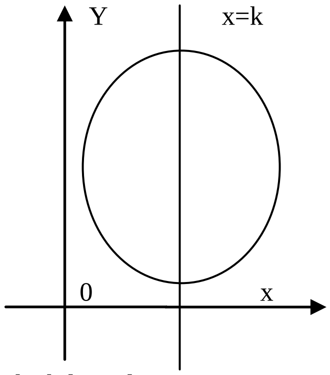

Figure.1. The bilateral symmetry axis is defined with a straight line.

This kind of symmetry is not very strictly. And, compared with normal brain MRI, the symmetry characteristic is distorted for the existing of brain tumor, such as the circumstance shown in Figure.3.a.

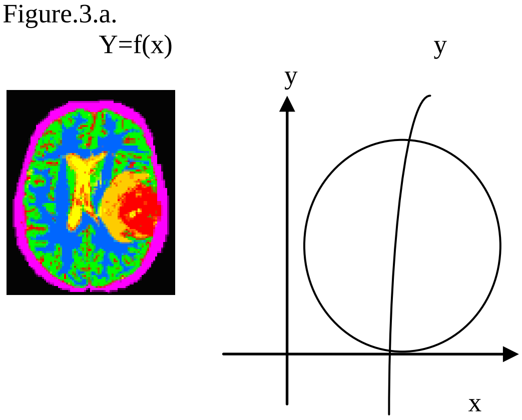

Figure:-3(a) The bilateral symmetry axis is defined with a curve line.

The symmetry axis can't be defined with a straight line in the brain MRI with tumors, so a curve line is more convenient to describe it.

For more convenient to describing symmetry axis, a curve line ($y= f(x)$, $x > 0$, $y > 0$) is defined, which is shown in Figure.3.b. From the edge map, the edge point set *Pe*can be obtained. And then, we calculate the edge-centroid *Gi*of every line according to equation (1).

$$Gi=1/k \sum_{j=1}^{k} Pi,j, \quad P\,i,j, \in Pe \ldots\ldots\ldots\ldots (1)$$

where, *Gi*is the abscissa of centroid in the *i* th line, *k* is the edge point number in the *i* th line, whose abscissas are *Pi,1…Pi,k* . So, based on the edge-centroids, we can use the least square method to get the symmetry curve line *y* approximatively.

V. Methodology Used

There are many techniques for brain tumor detection. We have used edge detection technique for brain tumor detection. Edge-based method is by far the most common method of detecting boundaries and discontinuities in an image. The parts on which immediate changes in grey tones occur in the images are called edges. Edge detection techniques transform images to edge images benefiting from the changes of grey tones in the images.

VI. Performance Evaluation

- If cutting of brain image gives symmetry by axis then there will not be chances of tumor this is detected by first algorithm otherwise there will be chances of tumor.
- As in others there are various steps are required to just identify whether there is tumor or not but in this it shows exact region where tumor is occurred.
- The color image is changes into gray scale image and then by reiterative processing the tumor is getting identified.
- Our purpose is to detect the tumor of brain automatically.
- Compared with other automatic segmentation methods, more effective the system model was constructed and less time was consumed.

Table 6.1: Number of detected edges

Patient ID	**Grade**	**Number of Detected Edges**		
		Robert	**Prewitt**	**Canny**
121	High	5259	4382	1997
122	High	5120	4323	1836
123	High	6807	5757	2302
124	Low	1491	649	317
125	Low	2509	1080	433

Table 6.2: Areas of tumor

Patient ID	**Lesion**	**Volume of tumor areas (Pixels)**	**% of Dama ge areas**
121	Left Frontal Parietal	4315	17.26
122	Left High Parietal	1068	4.27
123	Left Temporal Lobe	435	1.74

124	Left Frontal Parietal	1776	7.10
125	Left Thalamus	1060	4.24

VII. Conclusion

At first, it checks the image can be divided into symmetric axis or not. If it is divided into Symmetric part then no tumor in brain and it can be divided in curve shape then chances of tumor in human brain. However, if there is a macroscopic tumor, the symmetry characteristic will be weakened. Canny edge detecton technique use for the edge detection because it find true edges in the images and also work on the real images that reason result is better than other techniques.

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