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CYST DETECTION IN AN MRI SCANNED BRAIN IMAGES: A REVIEW

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Abstract

We propose a hybrid approach for classification of brain tissues in magnetic resonance images (MRI) based on genetic algorithm (GA) and support vector machine (SVM). A wavelet based texture feature set is derived. The optimal texture features are extracted from normal and tumor regions by using spatial gray level dependence method (SGLDM). These features are given as input to the SVM classifier. The choice of features, which constitute a big problem in classification techniques, is solved by using GA. These optimal features are used to classify the brain tissues into normal, benign or malignant tumor. The performance of the algorithm is evaluated on a series of brain tumor images.

1. INTRODUCTION

The principle of our task is to recognize a cyst from a particular MRI scan of a brain image using digital image processing techniques and compute the area of the cyst. A cyst is a closed sac, having a distinct membrane and division compared to the nearby tissue. It may contain air, fluids, or semi-solid material. There are hundreds of different types of cysts that can arise in the body. Colloid cysts are smooth, round lesions of end dermal origin, typically located at the foramen of Munro in the anterior aspect of the third ventricle. These cysts generally occur in adults and account for approximately 1% of all intracranial tumors. On non-enhanced computed tomography (CT), the majority of colloid cysts are hyper dense to brain tissue. A thin rim of enhancement is visible after intravenous contrast administration. Due to the proteinaceous nature of its contents, a colloid cyst is typically hyper dense on T1-weighted magnetic resonance (MR) images and hypo intense on T2-weighted MR. Typically, colloid cysts are clinically silent and are found incidentally when patients are imaged for other reasons. While some small colloid cysts may never cause any symptoms, those that grown to be sufficiently large in size can block the natural flow of cerebrospinal fluid (CSF) and lead to hydrocephalus and its associated symptoms such as headaches, weakness of the limbs, and loss of consciousness. These symptoms may be intermittent due to transient episodes of hydrocephalus that are caused by mobile cysts that occasionally block the flow of CSF. Other symptoms may vomit, nausea, blurred or double vision, downward deviation of the eyes, problems with balance and coordination, urinary incontinence, drowsiness, altered mental status, coma, or other changes in personality or cognition including memory loss. Colloid cysts are typically diagnosed through clinical neurological evaluation and by using brain imaging techniques such as computed tomography or magnetic resonance imaging (MRI). These imaging modalities can often demonstrate the cystic structure that is blocking the flow of CSF as well as any associated hydrocephalus. Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high resolution images of the parts contained in the human body. MRI imaging is often used when treating colloid cyst. These high resolution images are used to examine human brain development and discover abnormalities.

2. LITERATURE SURVEY

Sometimes, it is difficult to distinguish the benign tumor from malignant ones. With the aid of image processing methods such as mathematical morphology which define the edge of the images, it becomes easier to identify the sizes, shapes and characteristics of pathologic cell images [1, 2]. The edges of an image always include inherent information (such as direction, step character, shape, etc.), which are significant attributes for extracting features in image recognition. In most cases, pixels along an edge change gradually, whereas those perpendicular to the direction of the edge usually have much sharper changes. Generally speaking, arithmetic for edge extraction is to detect whether mathematical operators of the pixels are coincident with the features of the edge. Canny [3] derived analytically optimal step edge operators and showed that the first derivative Gaussian filter is a good approximation of such operators. An alternative to gradient techniques is based on statistical approaches. The idea is to examine the distribution of intensity values in the neighborhood of a given pixel and determine if the pixel is to be classified as an edge. In comparison with the differential approaches, less attention has been paid to statistical approaches. However, this method has been approached by some authors, e.g., Bovik et al. [4] and Yakimovsky. In the past two decades several algorithms were developed to extract the contour of homogeneous regions within digital image. A lot of the attention is focused to edge detection, being a crucial part in most of the algorithms. Classically, the first stage of edge detection (e.g. the gradient operator, Robert operator, the Sobel operator, the Prewitt operator) is the evaluation of derivatives of the image intensity. Smoothing filter and surface fitting are used as regularization techniques to make differentiation more immune to noise. Edge detection is a problem of fundamental importance in image analysis. In typical images, edges characterize object boundaries and are therefore useful for segmentation, registration and identification of objects in a scene. In other words we can say that an edge is not a physical entity, just like a shadow. It is where the picture ends and the wall starts. It is where the vertical and the horizontal surfaces of an object meet. It has no width because between a bright window and the darken of the right. Basically edge detection contains the following two parts:-

- Using edge operators the edge point set extracted.
- Some edge points in the edge point set are removed

Then they Obtained edge points are connected to be a line. Commonly we use following operators for edge detection e.g. Binary morphology, Canny, Log and Differential operator. Mathematical morphology is a well-founded non-linear theory of image processing. Morphological operations take into consideration the geometrical shape of the image objects to be analyzed. It contributes a wide range of operators to image processing, based on a few simple mathematical concepts. The operators are particularly useful for the analysis of binary images, boundary detection, noise removal, image enhancement, and image segmentation. Basic operation of a morphology-based approach is the translation of a structuring element over the image and the erosion and/or dilation of the image content based on the shape of the structuring element. A morphological operation analyses and manipulates the structure of an image by marking the locations where the structuring element fits. In mathematical morphology, neighborhoods are, therefore, defined by the structuring element, i.e., the shape of the structuring element determines the shape of the neighborhood in the image.

Morphology relates to structure or form of objects. Morphological filtering simplified segmented images by smoothing out object outlines using filling small holes, eliminating small projections. Primary operations are dilation and erosion. These operations use a structuring element which determines exactly how object will be dilated or eroded. Dilation process expanding image objects by changing pixels with value of "0" to "1". On the other hand the erosion process shrinking binary objects by changing pixels with a value of "1" to "0". There is also a combination of dilation and erosion called opening and closing. Opening is erosion followed by dilation.

Morphological edge detection algorithm chooses appropriate structuring element of the processed image makes use of the basic theory of morphology including erosion, dilation, opening and closing operation and synthesisation operations of them get clear image edge. Closing is a dilation followed by erosion. In [5] the effect of erosion and dilation operations is better for image edge by performing the difference between processed image and original image but they are worse for noise filtering. In brain MRI to find out the correct location of tumor and cyst can be proved to be very important in the early detection of pathological tissues and in minimizing the damage to healthy tissues, which may be due to any therapy procedure, like radio surgery etc.

The brain Fluid Attenuated Inversion Recovery (FLAIR) MRI offers a valuable method to perform pre and post-surgical evaluations. Most of the brain segmentation work till now is based on T1, T2 & PD weighted images where we have used Fluid Attenuated Inversion Recovery (FLAIR) images which is widely accepted for brain diagnosis. FLAIR sequences are that which produces heavily T2 weighted and cerebrospinal fluid (CSF) nulled MR images. With this technique, subtle lesions near the CSF stand out against a back ground of attenuated CSF fluids as cerebrospinal fluid (CSF) appears dark and most lesions, tumors and edematous tissues appear bright, providing improved discrimination between hyper intense lesions and neighboring fluid filled cavities by suppressing the fluid signal [6]. In all above work, either case studies are done or tumors alone are detected using FLAIR images but in previous work FLAIR images are used to detect tumor, cyst, wm, gm and csf using combined properties of wavelet and statistical parameters as the features of feature vector. Many authors used properties of wavelet transform coefficients and multi resolution theory only [7, 8] for the segmentation of images but a composite feature vector comprising of wavelet and statistical parameters in contrast to other researchers who have developed feature vectors either using statistical parameter or using wavelet parameters.

In R. Rajeswari et al. [9] proposed a Spectral leakage has the effect of the frequency analysis of finite-length signals or finite-length segments of infinite signals. In brain the tumor itself, comprising a necrotic (dead) part and an active part, the edema or swelling in the nearby brain, As all tumor do not have a clear boundary between active and necrotic parts there is need to define a clear boundary between edema and brain tissues. P. Narendran, V. K. Narendira Kumar, K. Somasundaram [10] proposed a new method for segmentation of pathological brain structures. This method combines prior information of structures and image information (region and edge) for segmentation. The automated brain tumor segmentation method that we have developed consists of two main components: pre-processing and segmentation. The inputs of this system are two different modalities of MR images: CE- T1w and FLAIR that we believe are sufficient for brain tumor segmentation [11].

3. Analysis of Problem

Medical image segmentation is an important technique in areas like help in diagnosis, detection of lesions, tumors, cysts or other abnormalities, surgical assessment and post-surgical assessment. It has long been used for tumor recognition as well as for determining tumor boundaries. Image segmentation techniques [12] are mostly used in medical field for detecting diseases in human body structures such as nerves damage, blood vessels extraction and tumor detection. Magnetic Resonance Imaging (MRI) is a non-invasive technique for medical imaging that uses the magnetic field and pulses of radio waves. It gives better visualization of soft tissues of human body.

The effect of erosion and dilation operations is better for image edge by performing the difference between processed image and original image, but they are worse for noise filtering. Hence in this work we analyse erosion and dilation problem with the help of merging these morphological output in which colloid cyst detect sharply. The basic purpose of the operations is to show only that part of the image which has the cyst that is the part of the image having more intensity and more area then that specified in the strel command. The basic commands used in this step are strel, imerode and imdilate, Imerode: It is used to erode an image. Imdilate: It is used to dilate an image. Marge these morphological outputs with grayscale image we get resultant output in which colloid cyst detect sharply.

The edges of an image always include inherent information (such as direction, step character, shape, etc.), which are significant attributes for extracting features in image recognition. In most cases, pixels along an edge change gradually, whereas those perpendicular to the direction of the edge usually have much sharper changes. Generally speaking, arithmetic for edge extraction is to detect whether mathematical operators of the pixels are coincident with the features of the edge.

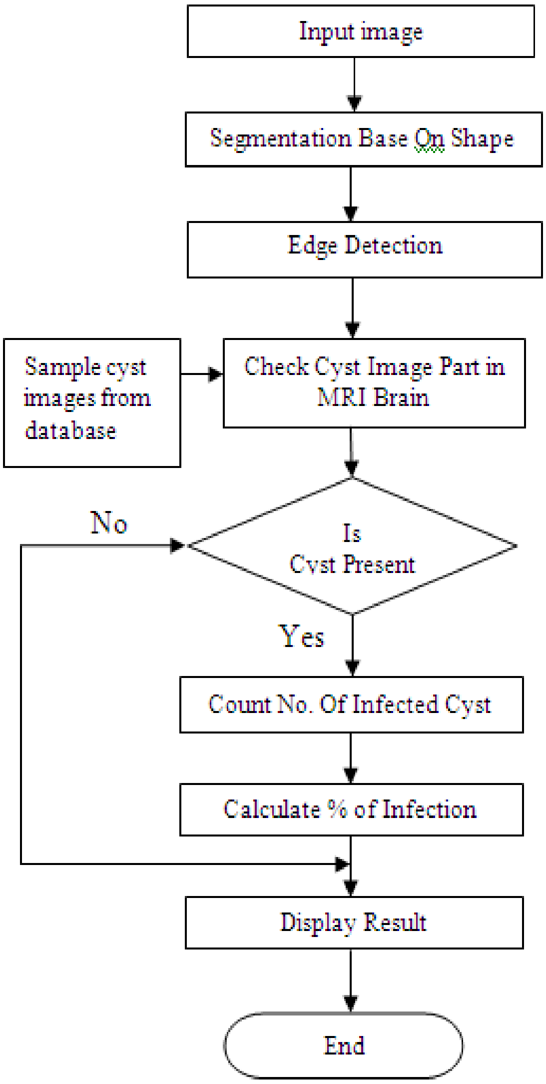

Figure 3.1 Data Flow digram of proposed method

Initially, an input image is taken in which cyst is to be detected. Then, a segmentation algorithm is applied to segment the desired part of the image based on shape and detect the cyst. Image segmentation is an essential process for most image analysis techniques. Segmentation subdivides an image into its constituent parts. Segmentation algorithms are based on one of the two properties of intensity values, namely discontinuity and similarity. First category is to partition an image based on abrupt changes in intensity, such as edges in an image. Second category is based on partitioning an image into regions that are similar according to predefined criteria. Histogram, thresholding approach falls under this category. Cyst images are stored in database, then check cyst image part in MRI brain. If the cyst is present in MRI brain image, then it count the no of infected cyst pixel and calculate percentage of infection and finally display the result. We have used these basic concepts to detect cyst in our work, the component of the image hold the cyst generally has extra concentration then the other segment and we can guess the area, shape and radius of cyst in the image. We calculate the area in pixel. The intention of these steps is fundamentally to recover the image and the image superiority to get more guarantee and ease in identify the cyst.

4. Applications

Application to several datasets with different cyst sizes, intensities and locations shows that it can detect and segment very different types of brain cysts with a good quality. Cyst detection in MRI brain image is generally useful in medical field.

1. Study anatomical structure.
2. Identify Region of Interest i.e. locate tumor, lesion and other abnormalities.
3. Measure tissue volume to measure growth of tumor (also decrease in size of tumor with treatment).
4. Help in treatment planning prior to radiation therapy; in radiation dose calculation.

CONCLUSION

The paper develops a hybrid technique with normal and benign or malignant classes. The propose approach gives very promising results in classifying the healthy and pathological brain. The benefit of the system is to assist the physician to make the final decision. The performance of this study appears some advantages of this technique: it is accurate, robust easy to operate, non-invasive and inexpensive. The approach is limited by the fact that it necessitates fresh training each time whenever there is a change in image database.

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