SEGMENTATION OF BRAIN TUMOR USING MORPHOLOGICAL OPERATIONS

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Abstract-

Medical images are extensively used by the doctors and researchers to find presence of abnormalities in human bodies and upgrading available technique respectively. This paper gives a technique for detection of brain tumor from Magnetic Resonance Imaging (MRI). MRI is an imaging tool used to identify and picture better-quality details of the internal organs of the body. MRI has better contrast for detecting soft tissues with good accuracy. Hence, MRI is widely used for the detection of brain tumor. Segmentation method for Magnetic Resonance Imaging (MRI) of the brain is one way the radiologist performs on the image for finding the tumor tissue from the normal tissue.However the images are degraded with a noise which creeps into the image while storage, transferring or fromhandling instruments. Preliminary step starts with pre-processing and that includes resizing of image, gray conversion. This is done to enhance the finer details and remove the noise from the image. Morphological segmentation is one of the most preformed operations in segmenting images based on grouping pixels that are of similar intensities. The use of the morphological functions is to break the tumor from the image and thus highlighting it. Now only the tumor portion of the image is visible, shown as white color.

Keywords: Brain Imaging, Brain Tumor, MRI, Noise Removal, Morphological Operators

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I. Introduction

Imaging human body organs for medical purpose is growing exponentially into a vital tool for clinical and research findings. To add strength for this increasing growth there is rise in advancement in diagnostic tools. Hence a spectrum of medical imaging tools is now at reach for the doctors, researchers [1]. The techniques produce unparalleled response in picturing inaccessible organs. These facilities help in visualizinganatomy and physiology of brain from cell level detailsto complete brain accurately. The increase in the growth of imaging is mainly due to their non invasive nature. Most tools operate without body contact, and also, they are real-time imaging tools. Researchers are the most benefitted because of modern imaging tools [2]. They get to see new things, thus finding the missing puzzle and solving the problem. It has helped in understanding the nerve paths, their network amongst themselves; brain functioning, intellectual process; finding out entry fordiseases; diagnose and prognosis of diseases, effective targeted treatment.For understanding the brain's anatomy, physiology and chemical process involved between cells a wide variety of imaging tools are deployed. They can be used in combination to know different functionalities of brain simultaneously.

The Physicians use various medical imaging methods to visualize the human body in the most accurate way. The tools they use for imaging are Magnetic Resonance Imaging (MRI), Ultrasound (US) imaging, and Computerized tomography (CT). The problem associated with processing a MR image is the noise artifacts corrupted into the image [3]. This makes the technician difficulty in spotting the tumor, estimating size. If the technician overlooks these data it will result in complication during the treatment process. Interpretation of data from medical image using computer aided techniques starts with the segmentation of image. Later steps include image reconstruction from the segmented image.

The brain is the most vital organ in the central nervous system. Tumor is unnatural uncontrolled proliferation of human cells. They can be benign or malignant. The position of tumor in the brain decides the effect on the brain activities. Thus varying for every individual's functioning and symptoms associated with the tumor. Magnetic Resonance Imaging (MRI) is the widely followed technique for diagnosis of tumor [4]. In Magnetic Resonance images, the huge volume of information is too much for manual processing and time consuming. Hence segmentation of brain tumor in MR images has grown into most sought area for research scholars as an emerging

method in medical imaging domain [5]. For effective treatment for tumor accurate localization and size estimation of tumor is very important. A competent algorithm for tumor detection based on morphological segmentation is proposed. After necessary imageenhancing process on the brain image, morphological operators are used to locate the tumor.

Segmentation of image is a vast topic and it contains different types of operator for segmenting. Segmentation in general means the process of splitting an image into number of pieces based on a criterion. The resulting image is no overlapping homogeneous by the criteria [6]. Morphological watershed segmentation is a type of segmentation process. Morphological Watershed Algorithm is a collective process that embodies detection of discontinuity, thresholding and region processing [7].

II. Related Literature

Mark Schmidt, IlyaLevner, Russell Greiner, Albert Murtha, AaloBistritz (2005) [8] proposed an alignment based segmentation tool for the brain. Since detecting and segmenting brain tumors inMagnetic Resonance Images (MRI) is a vital and time-consuming process for the physicians they tried to perform the task automatically. Automatic segmentation of brain images are not as easy as other body images because of the complex nature of brain itself and also image contrast of the normal and tumor tissue. They explored the use of aligned spatial templates to gather anatomical information of the brain. Their work involves quantitative evaluation of Alignment Based features. The performance of these features in determining information in supervised pixel classification is evaluated. The steps involved are comparing different AB features, exploring ways to combine them, and exploring combining AB features. They found Alignment Based tools gave a considerable performance increase by accomplishing segmentations that resembled expert quality results.

A. Padma, R. Sukanesh (2011)[9] gave the idea of automated classification and segmentation of brain tumor for CT images. They used Support Vector Machine classifier technique to form an effective segmenting algorithm for Computed Tomography images that could separate the tumor and normal brain tissues. The objective is to use the dominant grey level run length feature and deploying it for segmenting the tumor from the normal tissue. Grey level run length can be

obtained by ROI of selected region in the image. For this purpose, they had 120 CT images contain both normal and tumor images and produced an average accuracy of above 97%.

RachanaRana, H.S. Bhadauria, Annapurna Singh (2013) [10] reviewed the various available segmentation techniques for retrieving tumor details from a brain MRI. Their choice of segmentation algorithms were Fuzzy C-Mean, K-Mean and a Fast Bounding Box method. Segmenting brain tumor is a critical part in any diagnostic, surgery and treatment planning. The study showed the Fast Bounding Box method shuns contrast variations effectively. This technique is entirely unsupervised, time efficient, appropriate for most images, and improved contrast clarity.

Shital S. Agrawal, Prof. Dr. S. R. Gupta (2014) [11] proposed the various edge detecting algorithms for the detection of brain tumor. Detecting the edge is the important step in any segmentation technique. The edge marks the boundary of the tumor. This algorithm works based on the symmetric character of the brain and thus segmenting it. The results proved the algorithm is convenient and flexible.

VarshaKshirsagar, Prof. Jagruti Panchal (2014) [12] intended the idea of segmenting brain tumor from normal tissue and then calculation its area. This would help the physicians in treatment planning. They developed a single tumor detection algorithm which could picture the shape and size of the tumor. Since each tumor has different characteristics and requires different treatment approach, the single algorithm is robust and useful for all the types of tumor. Tumor detection and size estimation are done simultaneously by a single algorithm and hence it is time saving. From the area calculated, the stage of the tumor is also displayed.

III. Background work

Magnetic resonance imaging (MRI) found its wider application in medical field, which uses radio frequency pulses and magnetic field to produce images of the Brain. These provide detailed information of the organs, soft tissues in any plane. The obtained MRI from DICOM format has been converted to JPEG format. The MRI data is taken from DICOM library.

1. Proposed Methodology

The flow chart in fig1 illustrates the procedure of Brain tumour segmentation using morphological operation

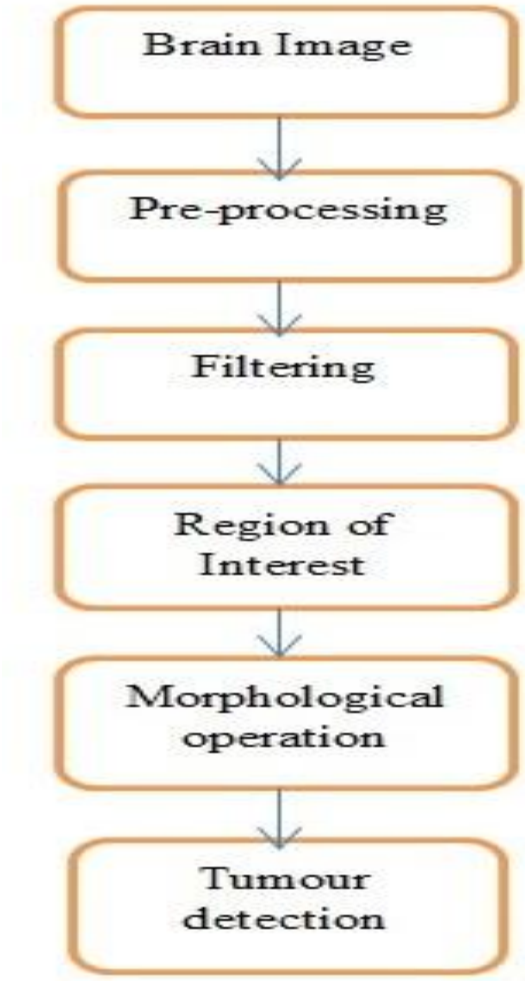


Fig1: Flow Chart of Brain Tumor

The MRI brain image is taken as an input image. The algorithm consist of Four stages

1. Pre-processing
2. Filtering
3. Thresholding
4. Morphological operations

The pre-processing stage includes gray scale conversion and enhancement of the image. The filtering techniques are used to remove high frequency components in the MRI Brain image. Segmentation plays an important role to extract tumor regions from MRI brain images. Morphological operations such as open, close, erode, dilate are used to enhance the quality of the image.

2. Pre-Processing:

Pre-processing is the initial step in the segmentation algorithm. The initial stage enhances the quality of the image without removing the information content in the image. This stage removes the patient name, age and markings noise and high frequency artifacts which are present in the image. The initial image is converted into gray scale image

Gray-scale image (x, y) = (0.3*Red) + (0.59*Green) + (0.11*Blue)

The enhancement of an image improves the perception of information in images to provide better input for further processing techniques. The gray level transformation is done by histogram equalization. The histogram equalization technique enhances the input image. The contrast could be enhanced by varying the intensity values of the image. This method gain higher contrast for areas having lower contrast region. The obtained image is sharpened by enhancing the color contrast around the edges using high pass filter. This filter retains the higher frequency components which are present in the image, by removing the low frequency information in the image.

3. Median Filtering

It is a nonlinear digital filter used to remove noise which is present in the image. Median filtering is widely used in later image processing because it preserves edges while removing noises. The median filter operates by replacing each entry with the median of the neighboring entry [1]. The median is obtained by sorting all the pixel values from neighborhood and replace the pixel by considering with the middle pixel value [2]

4. Thresholding

Segmentation is a process of isolating an image into different segments. Segmentation helps in better analysis and to locate boundaries and objects in an image [1]. The segmentation is a process of assigning a label to individual pixel so that pixel with common label shares certain characteristics. Each region in the pixel will have certain characteristics in common while the adjacent region will have different characteristics. The simplest method of segmentation is thresholding method which means assigning certain value to turn into binary image from gray scale image.

Thresholding changes all pixel value below certain threshold to zero and above threshold to one. j(x,y), i(x,y) is the pixels in the input image and output image. If i(x,y) has a threshold of j(x,y) at threshold K, then i(x,y) = 1 if j(x,y) > K and 0 if i(x,y) < k

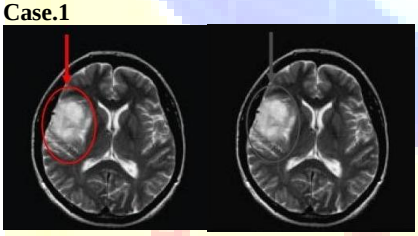
5. Morphological operations

The converted image contains imperfections because binary image produced by thresholding is distorted by noise and texture. Morphological operations identify objects and boundaries in an image. It's a logical operation based on pixel neighborhood comparison. They are performed on binary images. The pixel which has high intensity are grouped together and segmented as one cluster which act as tumour detected region.

IV. Experimental Results

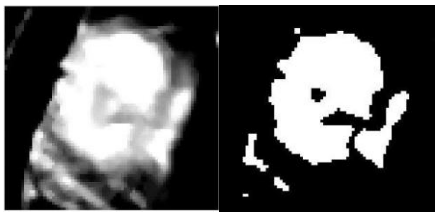
This paper deals with isolating a tumor region from MRI brain images. In order to determine the exact position and shape of the tumor region segmentation have been performed. The following figures show the output tumor segmented image. i.e. original MRI brain image, grayscale image, gradient MRI image, enhanced image, median filtered image, thresholded image, tumor region after morphological operations.

Case.1



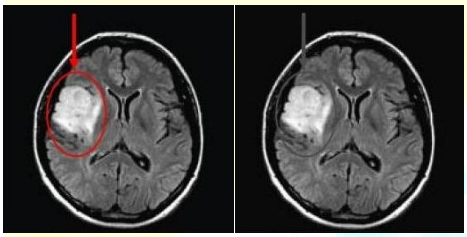
(a) (b)

(c) (d)

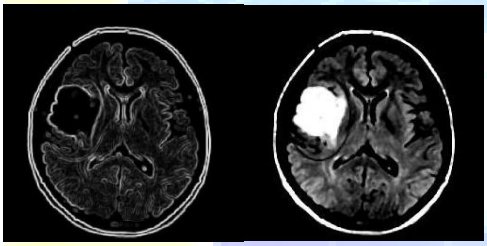


(e) (f)

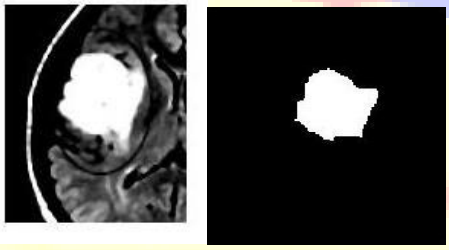
Case.2



(a) (b)



(c) (d)



(e) (f)

Fig2: [(a).original MRI brain image, (b).grayscale image, (c).gradient MRI image, (d).enhanced image, (e).median filtered image,(f). region of interest,(f). tumor region]

V. Reference

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