A Survey on Brain Tumor Detection using Magnetic Resonance Imaging

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Abstract —**Detection of brain tumor is the most common fatality in the current scenario of health care society. This difficult task of detection of brain tumor was earlier done by doctors manually, but it is tedious and time consuming and also different conclusions which may vary from one doctor to another. So magnetic resonance imaging (MRI) is used to detect the location of brain tumor and area calculation more accurately. It is a computer-aided system which is used for the detection and to calculate the area and gives more precise result and also saves the time in diagnosis of brain tumor. The different techniques using MRI are used to make the result superior. The main objective of this work is to highlight the various techniques used for detection and area calculation of the brain tumor.**

Index Terms— **Brain Tumor, Magnetic Resonance Imaging (MRI), Segmentation, Tumor Detection, Diagnosis**

***Index Terms*—Color dropout, Color space conversion, FPGA, MATLAB, Threshold detection, VHDL**

I. INTRODUCTION

A tumor is a mass of tissue that grows out of control of the normal forces that regulates growth. When most normal cells grow old or get damaged they die and new cells take their place. Sometimes, this process goes wrong. New cells form when the body doesn't need them and old or damaged cells don't die as they should. The buildup of extra cells often forms a mass of tissue called a growth or tumor.

Types of brain tumors are:

(a) Benign brain tumors do not contain cancer cells.
(b) Malignant brain tumors contain cancer cells.

The symptoms of a brain tumor depend on tumor size, type and location. Symptoms may be caused when a tumor presses on a nerve or harms a part of a brain. Also they may be caused when a tumor blocks the fluid that flows through and around the or when the brain swells because buildup of fluid. Headaches, nausea and vomiting,

Changes in speech, vision or hearing, problem balancing or walking, changes in mood, personality or ability to concentrate, problems with memory, muscle jerking or itching, numbness or tingling in the arms or legs.

Brain tumor as seen in Figure 1, can be diagnosed by using magnetic resonance imaging (MRI), ultrasonic, CT images and X-rays. Magnetic resonance imaging suggests more perfect information for medical examination than that of other medical images.

Brain tumor segmentation and quantification from MRI is a challenging task. The boundary of a tumor and its volume are important parameters that can have direct impact on surgical treatment, radiation therapy, or on quantitative measurements of tumor regression rates.

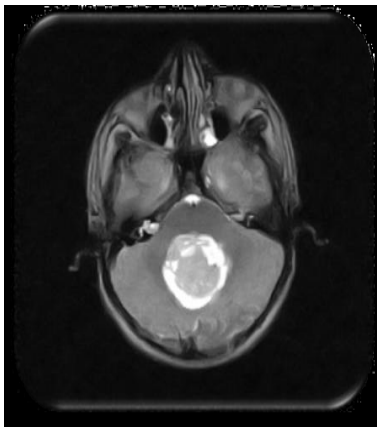

Figure 1: Brain tumor view inside brain

Automated brain disorder diagnosis with MRI is one of the specific medical image analysis methodologies. It involves two major steps: a) Image classification (b) Image segmentation.

Image classification is the technique of categorizing the abnormal input images into different tumor groups and image segmentation is used to extract the abnormal tumor portion which is essential for volumetric analysis. The rest of the paper is segmented into many sub-divisions which deal with the various techniques for image analysis.

II. LITERATURE REVIEW

There is various image segmentation techniques used for tumor detection:

A. Image enhancement

Automated brain disorder diagnosis with MRI is one of the specific medical image analysis methods. It consists of MRI scan, preprocessing, post-processing. In preprocessing some basic image enhancement technique are implemented. The purpose of these steps is basically to improve the image and the image quality to make more ease in detecting the tumor. The basic step in preprocessing is that the image is converted to gray scale image in first step. Noise is removed if any. The obtained image is then passed through a high pass filter to detect edges. Then the obtained image is added to original image to enhance it.

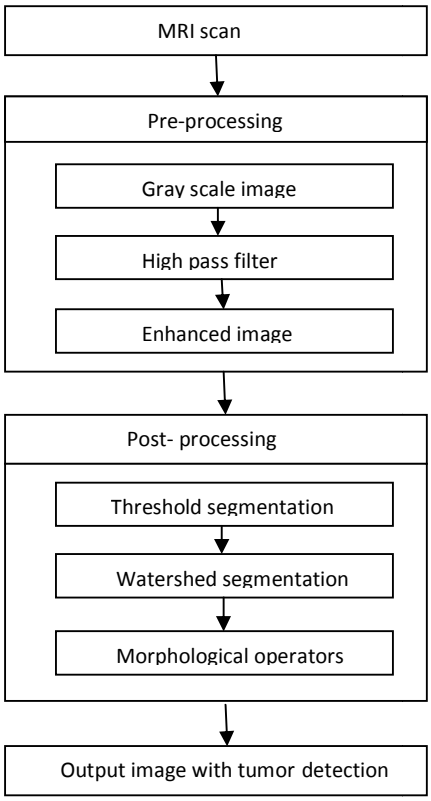

Figure 2: Steps to detect tumor in MRI

B. Image segmentation

Segmentation is done on basis of a threshold, due to which whole image is converted into binary image. MATLAB commands are used for this segmentation. It is the best method to segment an image to separate a tumor but it suffers from over and under segmentation. Morphological operations are applied on the image after converting it into binary form. The purpose of this operation is to show only the tumor part of the image having more intensity [1].

Image segmentation also represents a method to separate a portion into different area. The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be provided by the machine. Segmentation scheme consists of two stages. In the opening stages, the MRI brain image is obtained from patient database. In that film artifact and noise are disconnected. In the subsequent stages (MRI) segmentation is to precisely recognize the major tissue arrangement in these image areas and also the edema or swelling in the nearby brain. The component of the image hold the tumor generally has extra concentration then the other segment and we can guess the area, shape and radius of the tumor in the image and calculate the area in pixel. The noise is reducing by the conversion of gray scale image. Median filters have the robustness and edge preserving capability of the classical median filter. In pre-processing some fundamental image enhancement and noise lessening procedure are applied. Then this gray scale image pass in to the filter. Then we convert the filtered image into binary image by the thresholding method which computes a global threshold that can be used to convert an intensity image to a binary image with normalized intensity value between 0 and 1. The basic purpose of the operations is to show only that part of the image which has the tumor that is the part of the image having more intensity and more area [2].

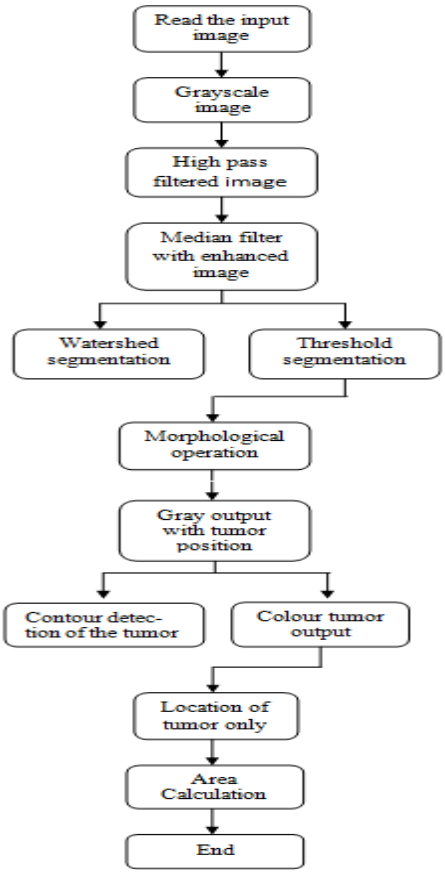

Figure 3: Flow Chart of Proposed Method

Image feature selection is a significant pre-requisite for most image processing algorithms, depending on these features the segmentation methods can be classified into three categories namely, thresholding and edge-based, region-based segmentation. Image thresholding is the most popular segmentation method due to its intuitive properties and simple implementation. Edge-based segmentation is described in terms of discontinuities in image attributes as Gray level, texture, color etc. These discontinuities are known as edges and are detected using edge detection operators, the widely accepted segmentation methods are edge-image thresholding which is used to eradicate insignificant edges that occur due to factors such as noise and improper lighting conditions. Stray edges problem can be solved if the edge properties are determined with respect to the mutual neighbors, while presence of edge is substantiated depending on the strength of edges in local neighborhood. Region-based segmentation is then used which is based on finding similarity measures to

merge and split regions in an image so as to form semantic or useful division in the processed image.

The proposed system is a modified version of the conventional PNN. The modification is based on automatic utilization of specified regions of interest (ROIs) within the tumor area in the MRI images. Form each ROI, set of extracted features include tumor shape and intensity characteristics are extracted and normalized. There are four major steps in the proposed approach for brain tumor classification. The first step is ROI segmentation in which the boundary of the tumor (ROI) in an MR image is identified. The second step is feature extraction of the meaningful features of the ROI. Third step is feature selection. The last step is classification process in which, learning a classification model using the features is carried out.

C. Quantification

Quantification is the aim in the diagnosis of the brain tumor. For the diagnosis of brain tumor from MRI compares the images obtained in different period. Other factors such as the tumor's shape, position and so on are important for diagnosis. But the accurate size of the tumor could not be measured manually so this task should be handled by computers. The quantification of segmented object is both in pixels numbers and in physical size [3].

D. Image optimization

Image optimization technology is the driving force which allows the simultaneous monitoring of expression for thousands of images. In this technique, an automatic and robust method for tumor image analysis and the related information retrieval module which is integrated with the proposed database schema for brain tumor image data. The dissimilarity of local color distribution is computed using a modified color histogram intersection technique that enables us to measure the discontinuity of colors at boundaries of objects efficiently [4].

The accuracy of the results depends on the image resolution, which has to be very high in order to provide as many details as possible. Pathologists and researchers, who work with biological tissues, in particular with the brain tumor image analysis technique, need to consider a large number of case studies to formulate and validate their hypothesis. Various statistical descriptors will proposed for the measure of image textures. Many of these techniques are first propose for processing images, and then were extended for color-texture processing. Proposed the use of a combination of color and texture features; texture features are computed in color scale and combined with color histogram and moments. These combined features are then sent to a classifier for color-texture classification [5].

Supervised and un-supervised segmentation method: supervised classification enables us to have sufficient known pixels to generate representative parameters for each class of interest. Parzen window classifiers are supervised classification algorithm. In an un-supervised classification pre hand knowledge of classes is not required and usually employees some clustering algorithm for classifying an image data. Un-supervised classification algorithm includes: K-Means, minimum distance, maximum distance and hierarchical clustering [6].

K mean is the unsupervised algorithms that solve clustering problem. The procedure for k mean clustering algorithm is simple and easy way to segment the image using basic knowledge of cluster value. In k mean initially randomly define k centroids. The selection of this k centroid is placed in cunning way because different location makes different clustering. So, better is to place centroid value will be as much as far away from each other. Secondly calculate distance between each pixel to selected cluster centroid. Each pixel compares with k clusters centroids and finds distance using Distance formula. If the pixel has shortest distance among all, than it is move to particular cluster. Repeat this process until all pixel compare to cluster centroids.

Time consumption during the segmentation of brain tumor from magnetic resonance imaging is a crucial drawback. Thus, we have studied the foundations of brain segmentation and edge detection, by various techniques employed by researchers.

The segmentation & edge detection approaches were studied under 5 categories. These are as follows- 1) Thresholding approaches, 2) Region growing approaches, 3) Genetic Algorithm approaches,4) Clustering approaches ,5) Neural network approaches. Several authors suggested various algorithms for segmentation.

E. Thresholding

Thresholding is one of simple image segmentation technique. It is process of separating pixels in different classes depending on their pixels gray levels. A thresholding method determines an intensity value, called the threshold, which separate the desired classes. The segmentation is achieved by taking threshold value. Based on threshold value, pixels are grouping with intensity greater than the threshold into one class and remain pixels grouping into another class. The mains disadvantage are that, in the simplest form only two classes are generated and it cannot be applied to multichannel images. In thresholding technique, image having only two values either black or white [7].

F. Region growing

It is a region based segmentation method. This process is first requirement of manually select seed points. Selection of seed points is based on user criteria. It is also iteration based method, like clustering algorithms. The region growing technique applied in medical image segmentation. In medical field, it can be applied in kidney segmentation, extraction of brain surface, cardiac images etc. the main disadvantage of this method is, it require user interface for selection of seed points. Thus for each region that selection of seed is require user interface and very time consuming process.

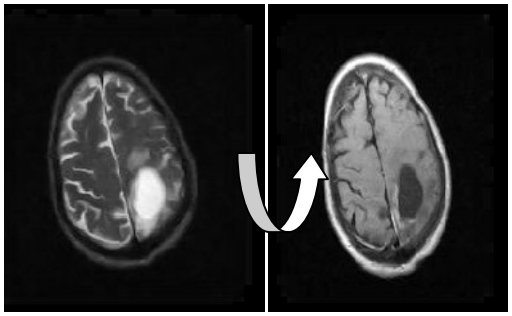

Figure 4: Segmentation through thresholding

G. Volume Detection by Ellipsoid-Diameter Technique

This methodology contains various processing steps, like raw image collection, image preprocessing, thresholding image segmentation and volume calculation. The sequences of the processing steps are arranged in a meaningful manner as shown in Figure 4.

The work carried out involves processing of MRI images that are affected by brain cancer for detection and classification on different types of brain tumors. The image processing technique like histogram equalization, image segmentation, image enhancement and then extracting the features using gray level co-occurrence matrix are used for detection of tumor. A suitable neuro fuzzy classifier is developed to recognize the different types of brain cancers. Images used era MRI images. The system is designed to be user friendly by creating graphical user interface (GUI).

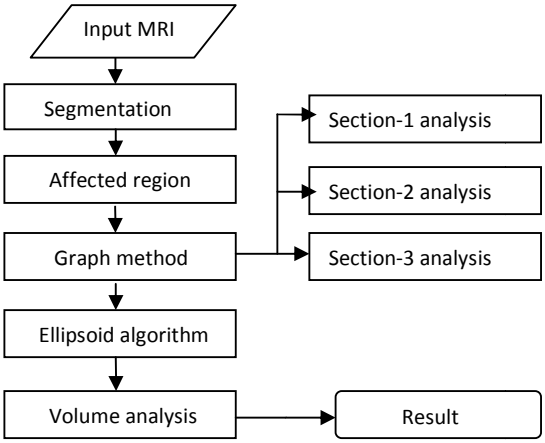

Figure 5: The Proposed methodology

In this study the tumor growth has been measured by graph based technique. Here input is the MRI image which is divided into four sections by one horizontal and vertical line shown in figure 5.

Figure 6: MRI Sections-I affected area

Region growing group's pixels or sub regions into larger regions based on predefined criteria. The basic idea is to start with a pixel or a group of pixels and examine the neighboring pixels. If a neighboring pixel meets a certain criteria, it is added to the group and if it does not meet the criteria, it is not added. This process is continued until no more neighboring pixels can be added to the group.

III. CONCLUSION

Imaging plays a central role in the diagnosis and treatment planning of brain tumor. We have studied several digital image processing methods and discussed its requirements and properties in brain tumor detection using magnetic resonance imaging (MRI). An efficient detection of brain tumor has been introduced by use of appropriate image segmentation method.

IV. FUTURE SCOPE

The goal is to detect, to segment, and to identify most types of pathological tissue that occur within pediatric brain tumors. Future research in the segmentation of medical images will lead towards improving the accuracy, exactness, and Computational speed of segmentation approaches, as well as minimizing the amount of manual interaction.

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