Computer Aided System for Detecting Brain Tumor using Magnetic Resonance Imaging with Classification Technique

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ABSTRACT

Medical image processing is the most challenging and emerging field now a days. Processing of MRI images is one of the part of this field. This paper describe the detection and segmentation of brain tumor using various segmentation algorithms along with that it finds the type of the tumor by using classification technique. Emergent research area in the field of medical imaging is the segmentation of brain tumor in magnetic resonance imaging, has it provide the detailed information to the anatomical structure of the brain. After segmentation of the brain tumor, classification technique is applied in order to obtain the type of the brain tumor. Finally the performances of the various segmentation algorithms are studied.

Keywords : *– Brain Tumor, MRI, Segmentation algorithms, Classification Technique.*

1. INTRODUCTION

Computer aided diagnosis is the automated system (detection) of brain tumor through MRI. Higher accurate reconstruction of the original image that is the valuable outlook and accuracy before brain tumor detection is possible through CAD. It consists of two or more stage, firstly pre-processing after that post processing that is segmentation. Then the detection strategies and other information's like classification and performance analysis are compared and studied. The Brain is the most complex and magnificent organs in the human body, has it gives us awareness of ourselves.

Brain tumor is a life threatening diseases which is increasing drastically among the humans. Brain tumor is a collection of abnormal cells in the brain. A trigger in a single cell's genes causes a change and makes into divide out of control. MRI is used in the biomedical to detect and visualize finer details in the internal structure of the body using strong magnetic field and radio waves. It is basically used to detect the differences present in the tissues, which have a far better technique compared to computed tomography. So MRI technique is a special one for brain tumor detection.

1.1 Types of Tumor

The word tumor is a synonym for a word neoplasm which is formed by an abnormal growth of cells [5]. There are 3 common types of tumor

- Benign

- Pre-Malignant

- Malignant

- **Benign Tumor**

  A benign tumor consists of very slow-growing cells, usually has distinct borders and rarely spreads. It does not affect its neighboring healthy tissues and also does not expand to non-adjacent tissues. A brain tumor composed of benign cells, but located in a vital area, can be considered life threatening although the tumor and its cells would not be classified as malignant.

- **Pre-Malignant tumor**

  Pre-Malignant tumor is a pre-cancerous stage, considered as disease, if not properly treated it may lead to cancer [5].

- **Malignant tumor**

  A malignant brain tumor is usually rapid-growing, invasive and life threatening. Malignant brain tumors are sometimes called brain cancer, which grows worst with the passage of time and ultimately results in the death of a person.

Digital Image processing is vast fields which can be used in various applications like medical field, for detection of the brain tumor in human brain. "Brain tumor detection is detection of tumor affected part in the brain along with its size"[5]. Brain tumor detection includes segmentation and classification technique.

2. PROBLEM STATEMENT

As the process of separation of cells and nuclei separation is very important much attention is needed in the development of expert diagnosis system for image segmentation and classification techniques. The commonly used imaging methods for diagnosis and follow up are computed tomography (CT) and magnetic resonance imaging (MRI). Both CTs and MRIs are using the computer graphics to create an image of the brain. As CT uses the X-ray radiation which leads harmful to human if there is a repeated exposure. So the MRI scans which is non-ionizing technique which is used for detection of brain tumor.

Brain tumors are very difficult to segment because they have a wide range of appearance and effect on surrounding structure and also they vary in size, position and image intensities. Manual brain tumor segmentation of brain tumors of MRI is a challenging and time consuming task and also MRI images have overlapping intensity with normal tissue and may be accompanied by surrounding edema (swelling). Due to that the computer aided system has been developed for brain tumor segmentation.

There are various techniques available for brain tumor segmentation such as

- Threshold segmentation

- Level Set Segmentation

- Active contour segmentation

- Watershed segmentation

After segmentation of the brain tumor the K-nearest neighbour classification technique is applied to obtain the types of the tumor.

3. RELATED WORK

Living creatures are made up of cells the adult body normally forms new cells only when they are needed to replace old or damaged ones. Brain tumor is a mass of unnecessary cells growing in the brain or central spine canal proposed by "American brain tumor association". Medical images are images that show the physical attributes distribution. Medical images are MRI, CT scan mostly depend on computer to generate the scanned image. Among MRI is the best because it utilizes non-ionizing radiation [1].

Segmentation of brain tumor is a challenging and difficult task because of the variety of there possible shapes, location and image intensities. Conversion of gray scale image to binary image format is thresholding and grouping of similar pixels into one is the watershed [5].

4. METHODS

A. Pre-processing of MRI image

B. Segmentation using Threshold, Watershed, Active contours, Level set algorithm.
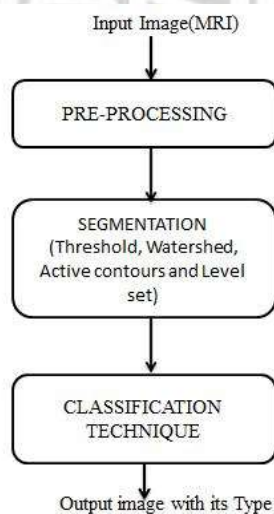
C. Classification of the segmented image.

Figure1: Proposed Architecture

The Figure 1 shows the architecture of the proposed method. This consists of three steps namely Pre-processing, Segmentation and Classification technique. Segmentation algorithms namely Threshold, Watershed, Active contours and Level set. The KNN is the classification technique. Finally obtaining the output image with its type of the tumor

4.1 Pre-processing of MRI image

Pre-processing stage includes enhancing the image in the way that finer details are improved and noise is removed. Processing stage consists of the following technique

- Conversion of MRI image into Gray scale image.

- Sharpening using imfilter

- Removal of noise.

- Enhancing the de-noised image using median filer.

4.2 Segmentation

The process of partitioning the image into multiple segments. The goal is to simplify or change the representation of an image into more meaningful and easier to analyse. Different types of segmentation techniques are used for segmentation based on application, a single or a combination of segmentation technique can be applied to solve the problem effectively.

- *Threshold Segmentation*

    Threshold segmentation is one of the simplest segmentation method .Here the input grey scale image is converted into binary format based on a threshold value. The main logic is a selection of threshold value for segmentation, here the threshold value is taken using histogram.

- Level Set Segmentation

    Level set is the numerical test of the active contour. The tumor detected part is obtained by the initializing the curve around the objects to be detected and move towards its interior normal until boundary of the object is appeared.

- Active Contours Segmentation

        The basic idea is to evolve a curve subject to constraints form a given image, to detect different objects in that image. The goal is to set the initial curve around the object to be detected and obtained the tumor detected part.

- Watershed segmentation
    It is a powerful mathematical morphological operating tool, here the pixels of the image are segmented on the basis of their intensities, and pixels falling under similar intensities are group together.

4.3 Classification Technique

Classification is a computational technique used to find pattern by assigning test sample to a class on the basis of knowledge gained by the classifier during training and develops classification schemas for data in very huge data sets.

KNN is one of the well-known and widely used non parametric pattern classification methods. Classifier computes the distance from unlabelled data to every training data point and selects the best k-neighbour with shortest distance. Euclidean distance is used for measuring distance.

5. DATA SETS

Data sets obtained from the Magnetic Resonance Imaging (MRI) scan of the brain. The collected data set consists of different types of tumor like Benign, Pre-Malignant and Malignant.
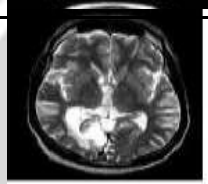
6 .EXPERIMENTAL RESULTS and DISCUSSION

Sl .No	Algorithms	Input image	Output image	Boundary extraction	Size and its Type
1	**Threshold and watershed**				216* 234 Pre-Malig nant
2	**Active contours**				813* 745 Malig nant

Table 1: : Experimental results

Table1 shows the input image which has brain tumor is shown in input image column. A combination of Threshold and Watershed segmentation is applied on input image. The result is shown in output image column which gives the tumor segmented part. Then the boundary is extracted from the segmented image which shown in boundary extraction column. Since the stage of the tumor based on the area of the tumor, The boundary extracted value is used for classification technique which shows the type of the tumor. Similarly the above procedure is applied for active contour segmentation technique.

7. ACKNOWLEDGEMENT

8. CONCLUSION

Here several brain tumor segmentation and detection methodology has been discussed for MRI of brain images. All the steps for detecting brain tumor has been discussed including classification techniques. Among the segmentation algorithm which are discussed here combination of threshold and watershed segmentation gives the accurate and effective result. For large data set accurate result can be obtained using KNN classifier which differentiate the segmented brain tumor image into its particular type of the brain tumor. In future 3D assessment of brain using 3D slicers with MAT LAB can be developed.

9. APPENDIX

CAD   - Computer Aided Detection
CT   - Computed Tomography
KNN   - K Nearest Neighbour
MRI   - Magnetic Resonance imaging

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