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An Efficient Approach for Multi-Modal Brain Tumor Classification using Texture Features and Machine Learning

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Abstract— In this paper, we propose an efficient approach for Multi-modal brain tumor classification using Texture features and Machine learning concepts. MICCAI BraTS 2016 datasets are utilized which are raw and skull-stripped and performed with high intensity. The project is divided into 3 primary modules such as Pre- processing, Feature extraction and classification of the brain tumor. We use techniques such as Fuzzy-c means clustering technique and further use region of interest properties for segmentation of the brain tumor. After the segmentation process, we use feature extraction techniques such as GLCM (Grey-level co-occurence matrix) and LBP (Local binary pattern) to record the outer shape and inner shape of the tumor by therefore extracting the following features such as Area, Density, Major axis, Minor axis length. The extracted features are then provided to the SVM (Support vector machine) classifier for classifying the tumor and categorizing it as BENIGN or MALIGNANT.

Keywords—Brain tumor, Segmentation, Benign, Malignant

1. INTRODUCTION

The detection and classification of Brain tumor is essential to decrease the number of casualties that are increasing each year. Brain tumor is a compound phenomenon in terms of controlling as well as curing it because of the complex structure of the brain. Tumor segmentation and classification is proven to be a challenging task and therefore less number of success rate has been achieved so far. Multi-Modal brain images has the ability to capture multiple images of the brain for a better result. Many researches based on mono-modality images had performed but the segmentation were not accurate. Recently, a notion of multi-modality images can segment brain tumor with high accuracy has been proved. MRI outputs multi-modal images with precise detection of the abnormality present in the brain. Brain tumor feature extraction and classification has received a huge amount of interest in the medical field over the past few years. Recent findings have stated that an individual with brain tumor should get immediate attention within hours of detection as the medication involved depends on each stage and type of the tumor. MRI images have proven to be a greater source for the classification of brain tumors.

The culmination of Texture Features and Machine learning concepts that have been explored in the segmentation technique with further implications such as using clustering techniques and region properties can bring forth a better segmentation. Tumor regions can be distinguished from normal brain cells by comparing the concentration of density in the tumor cells.

2. LITERATURE REVIEW

With the advancement of technology in the course of recent years, many methodologies have been proposed for brain tumor segmentation. Many research scholars and individuals have utilized various rationales and algorithms to execute their ideas in the field of medical sciences to segment the tumor.

Brain tumor segmentation activities are widely encouraged by the Medical Sciences department to reduce the pathologist's workload and thereby benefit the patients by reducing the expenses spent on biopsy reports.

1. *Title :* Brain Tumor Detection using Image Segmentation Techniques

Author : Dig vijay Reddy, Dheeraj, Kiran, Bhavana.V and Krishnappa H.K.

Year : 2018

Description: The methodology presented in this work uses a two-step procedure for brain tumor detection that combines k-means clustering algorithm followed by level set segmentation and morphological operations. Experimental results have shown that, this methodology is robust in detecting and bounding the abnormal cells in MRI images despite the complicate shape of the tumor. This paper proposed a k-means clustering image processing algorithm for brain tumor detection only.

2. *Title:* Detection of human brain tumour using MRI image segmentation and morphological operators**.**

Author: Anupurba Nandi Year: 2017

Description: In this paper the output image clearly shows the tumour cells have been separated from the healthy cells. The Threshold and Watershed segmentation is very simple and popular but using morphological operators is the new introduction to this problem which on applying

to the output image of other two provided a better detection of tumour. The factor used in thresholding is very difficult to determine because the factor used for one image may not work for other image. This factor may be different for different images. The watershed method has the disadvantage that it is highly sensitive to local minima, since at each minima, a watershed is created. This paper proposed a morphology based image processing algorithm for brain tumor detection only.

3 . *Title:* Segmentation of Brain Tumors in MRI Images Using Three-Dimensional Active Contour Edge.

Author: Ali M. Hasan, Farid Meziane, Rob Aspin and Hamid A. Jalab.

Year: 2015

Description: In this paper the proposed method can recognize and segment MRI brain abnormality on T2-w, T1-w, T1c-w, and FLAIR images. The 3DACWE segmentation technique reduces manual input, offers a rapid operation, and exhibits high accuracy compared with manual segmentation as evaluated. We conclude that the 3DACWE method is effective in brain tumor segmentation because the approach does not only consider local tumor properties, such as gradients, but also relies on global properties, such as intensity, contour length, and region length.

Although the achieved accuracy was high relative to those of other segmentation techniques, the 3DACWE was relatively slow for brain tumor segmentation. Such a slow pace was ascribed to the processing of a massive number of MRI slices of 512 512 pixel resolution with a high number of iterations used to attain the required accuracy. This paper proposed a texture based image processing algorithm for detection of tumor only.

3. PROPOSED METHOD

The proposed algorithm uses MICCAI BraTS dataset and the main flow of our proposed technique is presented in Fig.1 with further details present in following subsection.

A. Pre-processing

The pre-processing stage is the stage of rising operations involving images at the lowest abstraction level. The goal of the preprocessing stage is to process the image. All images are visualized through *Read medical data 3D* and segment the tumor using clustering techniques and to extract and classify the clustered image for better segmentation.

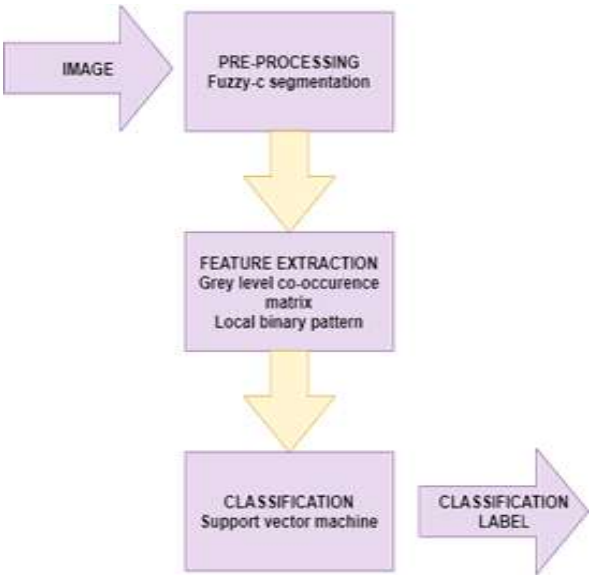

Fig. 1 Block diagram of proposed method

1. Resizing the input image

Input images are resized into an uniform size for reducing the distortion present (i.e) noise. Images that are processed without the default size can lead to distortion of the output, that would in return makes the segmentation to be less precise

2. Converting color format

Resized input images will be further checked for clarification on whether the image is in RGB or Gray scale. They will be translated to Gray scale format with an appropriate value, unless the resized images are in RGB scale. For improved tumor segmentation the Gray Scale image is further transformed into the Black and White image.

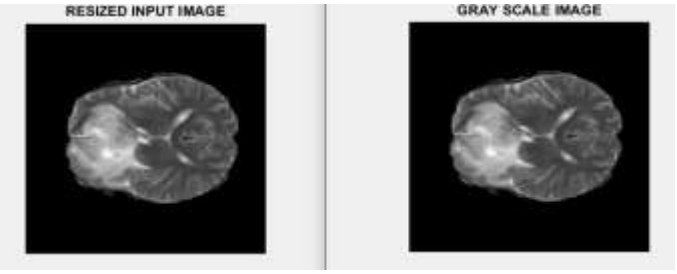

Fig. 2 Resized input image with gray scale conversion

Fuzzy-c means clustering algorithm is one of the most commonly used clustering technique in the field of medical imaging. Clustering techniques are used to group the abnormal areas of the brain and these clustered abnormal images are used to extract the tumor by incorporating with region of interest properties such as area and density to distinguish the tumor region and detect the tumor.

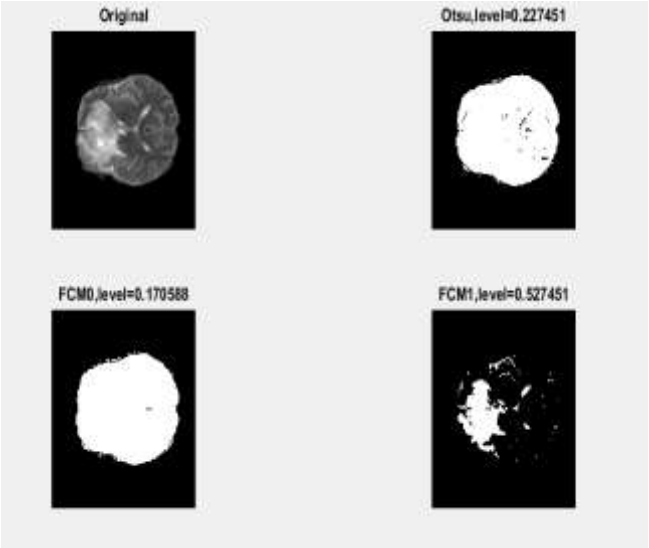

Fig. 3 Fuzzy-c means segmentation

B. Feature extraction

Feature extraction is the process of masking the particular brain tumor part and extracting the tumor region to enhance the textures of the image. In feature extraction, texture features plays a major role in extracting spatial arrangement of color or intensities in the image or selected region in the image. For analyzing the texture features, Gray level co-occurrence matrix and Local binary pattern are used.

Gray level co-occurrence matrix has features such as extraction of color, shape, skewness and so on. In gray level co-occurrence matrix, Homogeneity measures the closeness of the distribution of the elements in the inner ridges. Local Binary pattern represents the homogeneity involved in the distribution of elements in outer edges of the tumor.

C. Classification

Supervised classification is a machine learning approach in which training data are used to construct the model on unseen data to measure the performance of the algorithm. Support Vector Machine is the classifier used in this work to classify the data and categorizing it by Benign or Malignant. SVM is generally a binary classifier and can be used for both linear and non-linear operations. Linear operations is performed in this work as it involves multiclass operations and Support vector machine provides better classification in terms of multiclass operations. Extracted tumor images using texture features are produced to the SVM classifier which measures the performance of the algorithm with the unseen data.

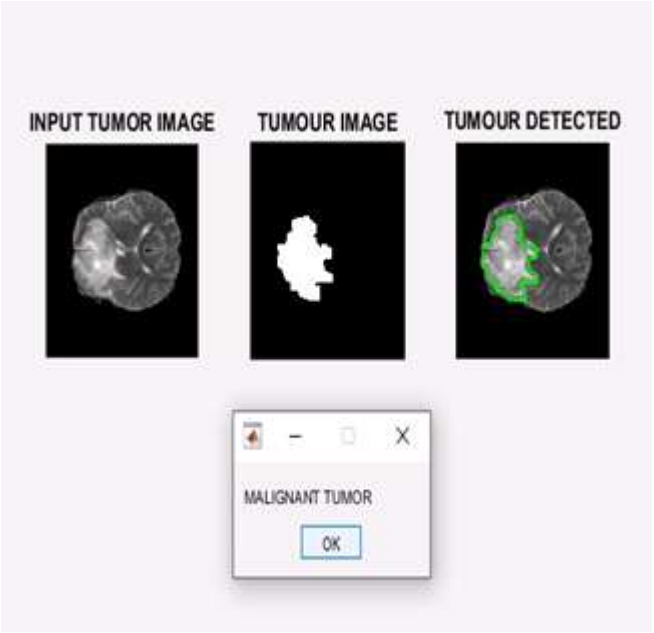

Fig. 4 Malignant tumor classification

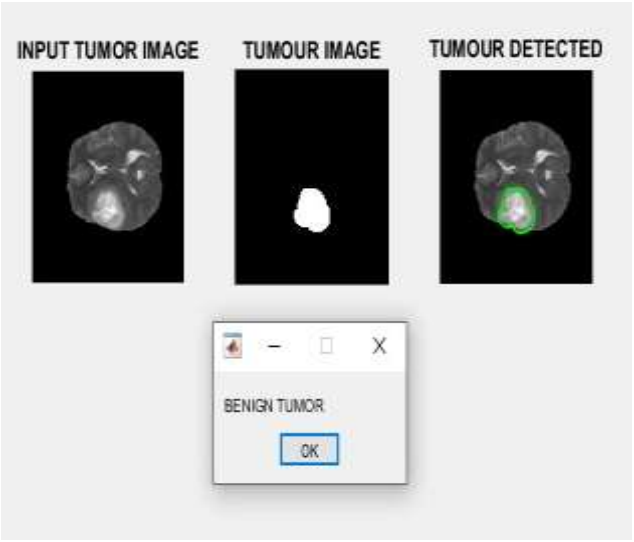

Fig. 5 Benign tumor classification

4. CONCLUSION

This paper presented an hierarchial way of classifying the tumor into two types such as Benign or Malignant. Segmentation techniques, region properties and Texture features are extracted and utilized in the MRI images with SVM classifier. The use of Fuzzy-c segmentation with Region of interest properties has increased the segmentation accuracy which then contributed to better classification of the tumor.

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