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Detection of Brain Tumor Using Digital Image Processing

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Abstract

Brain tumor detection is an important task in medical image processing. Early diagnosis of brain tumors plays an important role in improving treatment possibilities and increases the survival rate of the patients. The detection of brain tumor from Magnetic Resonance (MR) images is a vital, but time consuming task performed by medical experts. The knowledge of this information regarding tumor in the brain is important for diagnosis planning and treatment. The location of the brain tumor and precise size are detected with brain tumor detection. Sometimes MRI brain images corrupted by some noise. In this project we specially focus on detecting tumor from brain MRI images. By using thresholding technique extraction of the tumor takes place and then calculates the tumor area.

Keywords: Medical image processing • Magnetic Resonance Imaging (MRI) • GUI (Graphical User Interface) • Pre-Processing and enhancement • Thresholding • Image segmentation • Feature extraction and classification

Introduction

Medical image processing is the most vast and important field today. This project describes the methodology of detection & extraction of brain tumor from patient's MRI scan images of the brain. In this project, a method for segmentation of brain tumor has been developed on MRI data which allows the identification of Tumor tissue with high accuracy and reproductability compared to manual techniques. This method incorporates with some noise removal functions and segmentation which are the basic concepts of Image processing [1].

Magnetic Resonance Imaging (MRI) is an enhanced medical imaging technique used to produce high quality images. From these high-resolution images, we can easily extract the detailed information to examine human brain development and discover abnormalities. The MRI (magnetic resonance imaging) has become more useful medical diagnostic tool for diagnosis of brain and other medical images. The process to detect the brain tumors through MRI images can be categorized into four different sections; pre-processing, image segmentation, feature extraction and image classification [2].

The Brain Tumor is affecting many people worldwide. Brain Tumor is the abnormal growth of cell inside the brain which limits the functioning of the brain. It can effect proper brain function and be life-threatening also. Two types of brain tumors have been identified as Malignant and Benign. Malignant tumors are fast growing and cancerous. Benign are slow growing and non-cancerous and less harmful than malignant. Early detection of the brain tumor is possible with the advancement of Image Processing (IP) [3].

The Pre-Processing, Segmentation, Optimization and Feature Extraction followed by classification, size and volume detection and stage detection. These techniques allow us to identify even the smallest abnormalities in the human brain. The goal of medical imaging is to extract accurate information from these images with the least error possible; it converts the original image to a compact form. If the MRI is given as an input, it can be converted into a gray scale image and using various other techniques, Brain tumor can be detected [4].

In this project we are going to diagnose brain tumor using digital image processing. The main approach of this project is to detect tumor in more efficient way.

Research Methodology

Firstly, in the step first the MRI images are pre-processing and enhanced for the further process. The second step is of image segmentation for the tumor detection [5]. In the third step the feature extraction is done by using thresholding technique. In the last and final step the classification is done on MRI Images. Hence, by using the Waterfall Model we conclude our project of brain tumor detection which is shown in Figure 1.

Literature Review

In this project we have discussed about some related work have done on brain tumor detection using digital image processing approach.

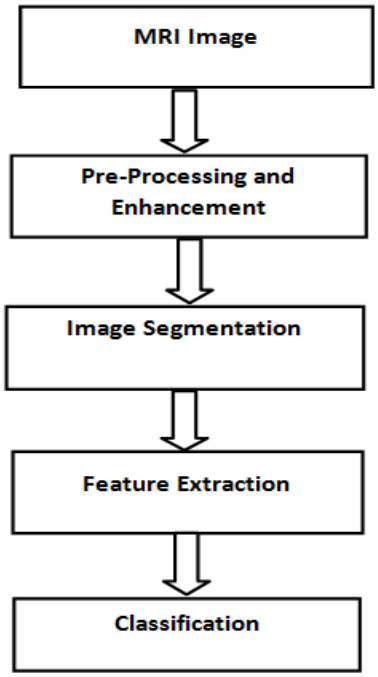

Figure 1. Waterfall model.

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Selvaraj Damodharan

This paper applied a neural network based technique for brain tumor detection and its classification, and more precisely the quality rate is produced separately for segmentation of WM, GM, CSF, and tumor region and an accuracy of 83% using neural network based classifier. Alfonse and Salem presented a technique for automatic classification of brain tumor from MR images using an SVM-based classifier [6]. That improve the accuracy of the classifier, features are extracted using fast Fourier transform (FFT) and reduction of features is performed using Minimal-Redundancy-Maximal-Relevance (MRMR) technique. This technique has obtained an accuracy of 98.9% [7].

Kumar and Vijayakumar

This paper presented brain tumor segmentation and classification based on principal component analysis (PCA) and radial basis function (RBF) kernel based SVM and claims similarity index of 96.20%, overlap fraction of 95%, and an extra fraction of 0.025%. The classification accuracy to identify tumor type using this method is 94% [8].

Wenchao Cui

This paper presented a localized fuzzy clustering with spatial information to form an objective of medical image segmentation and bias field estimation for MR images of brain. In this method, authors use Jaccard similarity index as a measurement of the segmentation accuracy and claim 83% to 95% accuracy to segment WM, GM, and CSF [9].

Ahmad Chaddad

This paper presented a technique of automatic feature extraction for brain tumor detection based on Gaussian mixture model (GMM) using MR images. In this method, using principal component analysis (PCA) and wavelet based features; the performance of the GMM feature extraction is enhanced. An accuracy of 97.05% for the T1-weighted and T2-weighted and 94.11% for FLAIR-weighted MR images are obtained.

S. N. Deepa

This paper presented a technique of extreme learning machine for classification of brain tumor from 3D MR Images.; this method obtained an accuracy of 93.2%, the sensitivity of 91.6%, and specificity of 97.8% [10].

Jainy Sachdeva

This paper presented a multiclass brain tumor classification, segmentation, and feature extraction by using a dataset of 428 MR images, in this method, authors used ANN and then PCA-ANN. The increment in classification accuracy from 77% to 91% [11].

N. Nandha Gopal and M. Karnan

This paper presented a smart system it is designed to diagnose brain tumor through MRI by using image processing clustering algorithms i.e. Fluffy C Means along with intelligent optimization tools as Genetic Algorithm (GA), and Particle Swarm Optimization (PSO). Hence the average results classification error of GA is 0.078%, the average accuracy GA is 89.6%. And PSO gives best classification accuracy and average error rate, average classification error of PSO is 0.059% and the accuracy is 92.8% and tumor detection is 98.87%. Therefore, we saw that average classification error is reduced when the number of sample is increased. This report has provided substantial evidence that for brain tumor segmentation of PSO algorithm performed well [12].

Ehab F. Badran, Esraa Galal Mahmoud and Nadder Hamdy

This paper presented an innovative system which can be used as a second decision for the surgeons and were based on adaptive thresholding. That determines whether an input MRI brain image represents a healthy brain or tumor brain as percentage. It defines the tumor type; malignant or benign tumor [13].

Sahar Ghanavati, et al.

It causes to an automatic tumor detection algorithm using multi-modal MRI. In this the results show 100% detection rate in all our test sets including simulated and patient data with an average accuracy of 90% [14].

Rupsa Bhattacharjee and Monisha Chakarborty

This paper presented a new technique for brain tumor detection from diseased MR images is developed in it; this would enhance the efficiency of the detection and would stretch it to further disease classification [15].

Khurram Shahzad, Imran Siddique and Obed Ullah Memon

This paper presented the Morphological operation like erosion and dilation along with morphological gradient and threshold are used. In this the experimental results show that designed algorithm is fully automatic, easy and very successful in detection and extraction of tumor form MR Images [16].

K. Sudharani, T.C. Sarma and K. Satya Prasad

This paper presented the various techniques like Brightness Adjustment, Re-Sampling of the Image, Color Plane Extraction, Histogram Processing, Tumor Measurements, Thresholding and FFT and after mathematical calculation it results such as Sensitivity is 88.9%, Specificity is 90%, Accuracy is 89.2 and Similarity index is 93.02%, this calculations will help in the process of diagnosing the tumor [17].

Ali Isin, Cem Direkoğlu and Melike Şah

In this paper the reported results indicate BRATS dice scores of 83.7% for the whole tumor region, 73.6% for core tumor region and 69% for active tumor region. It is important to note that, these results are obtained with a limited dataset which might affect the performance [18].

Paramveer Singh Samriti

This paper proposed study about how image segmentation plays an important role in medical image analysis. Author has used hybrid approach that they have used a hybrid of two different techniques, i.e. Watershed and Contrast Technique. This segmentation method gives high accuracy as compare to other methods [19].

Heba Mohsen, El-Sayed A. El-Dahshan, El Sayed M. El-Horbaty and Abdel-Badeeh M. Salem

This paper achieves 96.97% by using the DNN algorithm and the DNN classifier shows high accuracy compared to traditional classifiers [20].

Kamil Dimililer and Ahmet Ihan

This paper proposed he testing image sets of IWNN and IPWNN results were successful and encouraging and an overall correct identification of IWNN yielded 83% correct identification where, 25 images out of the available 30 brain images yielded. The overall correct identification of IPWNN yielded 90% correct identification where, 27 images out of the available 30 brain images yielded. Thus successful result was obtained by using only the database of images for training the neural network [21].

Vishal S. Shirsat and Seema S. Kawathekar

The proposed Algorithm was tested with the brain having different intensity, shape and size, the method was successful to competently extract the tumor part from the brain tumor images, this method was tested using MATLAB 2012a for result analysis receiver operating characteristic curve (ROC) is used and this algorithm achieves sensitivity equal to 80% and specificity equal to 23% and accuracy is 0.9902. ROC curve which is helpful for the classification of the research work and also it gives the accuracy [22].

Objectives

This project aims that:

- To find the proper and appropriate result through the MRI scan images.

- This project also aims that it covers the process of the detection of the brain tumor by performing various operations on the MRI scan images.
- In this project we also going to measure the size of the brain tumor as well as also going to detect the stage of the disease through the MRI scan images.
- The main objective of this project is to diagnose of the MRI scan images for the recovering of the disease of the patient.

Limitations

Study analyzed the difficulty with detection of disease that is:

- To get the proper and appropriate result from the MRI Scan images, one should have to perform many operations like thresholding, erosion, dilation, image enhancement etc.

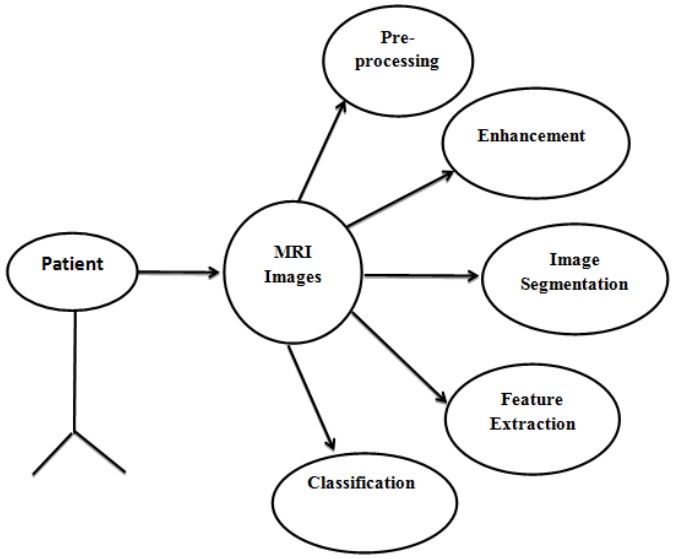

Figure 2. Brain tumor detection using digital image processing.

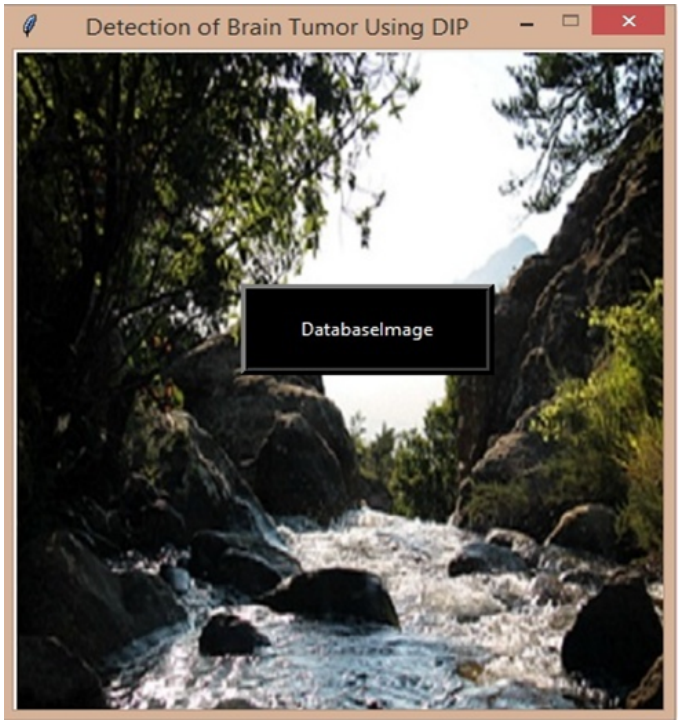

Figure 3. The main window of the GUI development.

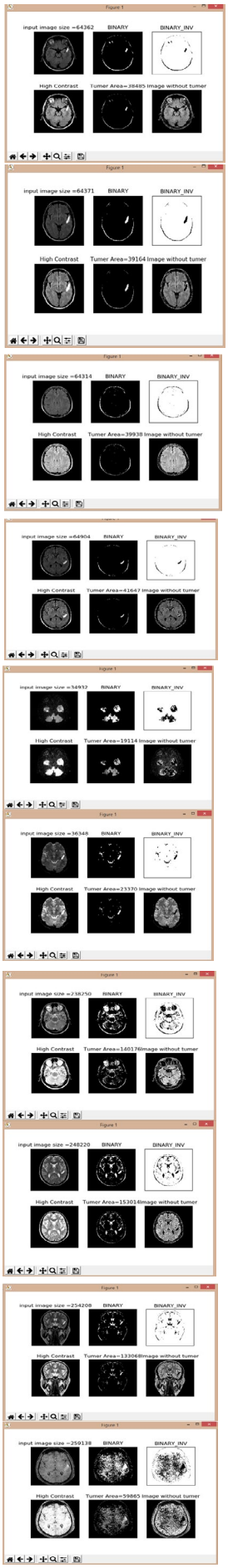

Figure 4. The output of the operation applied on the multiple MRI images of the database.

- It is very lengthy, slow and time consuming process.
- From the doctors perspective it is very lengthy process and from the patients perspective it is very time consuming.
- Hence, one should have to wait for a long time.
- The difficulty is time; it consumes lots of time for to complete the whole process.

Gui Development (Design)

Figure 2 shows the detection of Brain Tumor using Digital Image Processing. Figure 3 shows the main window of our GUI, there is a button which enables you to perform the operation for brain tumor detection. Here we apply the operation on the multiple MRI images of our database, and the output is as shown in the Figure 4.

Results

After the completion of this project, it is going to be introduced into the real sense. We are going to make this GUI of tumor detection to all the users from all around the world. Using this GUI user will be able to detect the tumor and also measure the size of tumor by applying various processes in digital image processing. Thus the GUI will make useful to society. Results of this GUI have been analyzed properly in order to make the GUI of tumor detection more accurate [23].

Conclusion

In the proposed work several methodologies are examined to denote the conventional stages of MR image processing also analyzed individual segmentation approach. The process of identifying brain tumors through MRI images is categorized into four different sections and i.e. pre-processing, image segmentation, feature extraction and image classification.

In this project, threshold technique is used for tumor detection. Threshold is used to binarize the image which results an image having tumor and some noise with it. This project can help to detect and extract tumor of any shape, intensity, size and location. The result shows that our project can efficiently enhance and retains the original shape of tumor. Thus this project is very easy and efficient in extracting any type of tumor but the decision and diagnoses depends upon expert doctor.

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