ISSN:2347-7385

An Ensemble approach for Classification of Glioma using MR Images

Ashwini V D* Divya R **Chaitra A*** Dheeraj D****
Dept Of CSE, REVAITM, Bangalore, Karnataka
ashwini.dinni@gmail.com*divyaaraaman95@gmail.com**a.chaitra5@gmail.com***
dheerajd@revainstitution.org****

Abstract: Today, detection of tumors in human brain in the field of image processing has become a challenging task. Abnormal cells in the brain are considered as tumor. Brain tumors can be cancerous or noncancerous. Glioma is the most occurring type of brain tumor in humans which makes up about 30% of central nervous system and brain and 80% of all malignant brain tumors. The most widely used modality for brain tumor analysis is Magnetic resonance imaging (MRI). In current practice, using an MRI and sometimes with the help of a biopsy, a doctor would diagnose a tumor to be benign or malignant. In our work around eighty MRI images including T1 and T2 weighted samples, FLAIR and ROI samples are collected from radiologists and global dataset BRAININX for experimentation. In this paper we propose an ensemble approach like Global thresholding, morphological feature extraction techniques combined with non parametric local transforms for detection of tumor.
Keywords: Glioma, non parametric local transforms, segmentation, global thresholding.

I. INTRODUCTION

In imaging science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame. The output of which may be either an image or a set of characteristics or parameters related to the image.

Biomedical Imaging being the science and the branch of medicine is concerned mainly with the development and usage of imaging devices and techniques to obtain internal anatomic images. It also provides biochemical and physiological analysis of tissues and organs. Biomedical imaging concentrates on the capture and display of images for both diagnostic and therapeutic purposes, and modern imaging technology is 100% digital. Biomedical imaging technologies utilize either x-rays, MRI, SPECT, PET or OCT to assess the current condition of an organ or tissue for monitoring health of patient over time that helps in diagnosis and treatment evaluation. Medical imaging can be structural or morphologic, e.g. CT, MRI, OCT or functional PET, SPECT.

Magnetic resonance imaging (MRI) is a medical imaging procedure that uses strong magnetic fields and radio waves to produce cross-sectional images of organs and internal structures in the body. The variation in the signal captured by the MRI machine depends on the level of water in the body along with local magnetic properties of a particular area of the body. Using MRI scans, physicians can diagnose or monitor treatments for abnormalities of the brain and spinal cord. Tumors are group of abnormal growth of tissue cells that forms lumps which can be either benign or malignant. Glioma is a type of tumor that arises from glial cells commonly seen in human brain. There are different types of normal glial cells that can also produce tumors. Astrocytes produce astrocytomas), Oligodendrocyte produces oligodendrogliomas, and ependymal cells produces ependymomas. Tumors that display a mixture of these different cells is called mixed gliomas. Based on the grades, Gliomas are further categorized as Low-grade gliomas which tend to exhibit benign tendencies and portend a better prognosis for the patient. However, if they have a uniform rate of recurrence based on the increasing growth in their grade over time then they are classified as malignant. High-grade gliomas are undifferentiated and are malignant hence carry a worse prognosis.

II. LITERATURE SURVEY

Ishmam Zabir and et.al [1] have developed a work on "Automatic Brain Tumor Detection and Segmentation from Multi-Modal MRI Images Based on Region Growing and Level Set Evolution". In this paper they have proposed a work on Region growing and Level set Evolution. The segmented area obtained from the conventional region-growing approach is automatically selected as the initial contour to the iterative distance regularized level set evolution method thus removing the need of selecting the initial region of interest by the user. The proposed method is capable of improving the overall detection and segmentation performance of tumor for different glioma cases of BRATS 2012 publicly available database. The experimental results are, the mean dice co-efficient of above 80% shows promising results that can help in automation of the brain tumor segmentation from MRI images. It also indicates that, segmentation performance varies from 55-95% dice coefficient for different cases

Ruixuan Lang and et.al [2] proposed a work on "Brain tumor image segmentation based on convolution neural network" In this work they have proposed a new Conventional neural network

ISSN:2347-7385

(CNN) based on traditional CNN for automatic brain tumor segmentation, which combines multi-modality images. The developed CNN model in this work automatically learns useful features from multi-modality images to combine multi-modality information. Thus the performance of CNN is measured and evaluated by selecting the best two algorithms Bauer and Menze in BRATS.

Yuan Gao and et.al [3] proposed work on "Histological Grade and Type Classification of Glioma Using Magnetic Resonance Imaging". In this work, paper uses a high-throughput image feature analysis technique to estimate the histological grade and type of a patient using MRI. The proposed method consists of the initial label definition, the region-of-interest delineation, the self adaptive feature extraction, the feature subset selection, and the multi-class voting classification. A total of around 120 patients with the grade II-78, grade III-25 and grade IV-21 and with astrocytoma-86, oligodendroglioma-16, oligoastrocytoma-22 respectively were chosen for experimentation. A leave-one-out cross validation technique was applied to record the results of accuracy and macro average as 88.71% and 0.8362 respectively for the grade classification and 70.97% and 0.5692 respectively for the type classification.

Praskash Tunga P and Vipula Singh [4] have developed a work on "Extraction and Description of Tumor Region from the Brain MRI Image using Segmentation Techniques". In this work, the paper focuses on extraction of brain tumor and its region description through segmentation from the brain MRI image. Brain tumor extraction is done by comparing the analysis of three methods k-means clustering, morphological operations and region growing.The experiment was carried out on 10 brain MRI (axial scan) images.

Parveen and Amritpal Singh [5] have developed a work on "Detection of Brain Tumor in MRI Images, using Combination of Fuzzy C-Means and SVM". In this work they have proposed a hybrid technique of SVM and Fuzzy C-Means which uses Data mining methods on analysis of 120 images. In this algorithm the image is enhanced using enhancement techniques such as contrast improvement, and mid-range stretch. Skull Stripping uses double thresholding and morphological operations along with Fuzzy c-means (FCM) clustering for the segmentation of the image to detect the suspicious region in brain MRI. Grey level run length matrix (GLRLM) is used for extraction of feature from the brain image, after which SVM technique is applied to classify the brain MRI images. The experimental results are, Total of 96 brain MRI images was choosen for training and about 24 brain images were choosing for testing of which accuracy for the kernel function viz Linear has 91.66%, Quadratic has 83.33% and Polynomial has 87.50%. Further the performance measures are also calculated, like Sensitivity for linear, quadratic and polynomial are 83.33%, 66.66% and 75% respectively and Specificity for linear, quadratic and polynomial are 100% respectively. Thus the combined approach provides a good performance.

Swapnil R. Telrandhe and et.al [6] have developed a work on "Detection of Brain Tumor from MRI images by using Segmentation and SVM". In this work they propose adaptive brain tumor detection technique using K-Means segmentation which contains a denoising Median filter and skull masking with preprocessing of image using an unsupervised Support Vector Machine (SVM).

Ming-Ni Wu and et.al [7] have developed a work on "Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation". In this work they propose a color-based segmentation method that uses the K-means clustering technique to track tumor objects in magnetic resonance (MR) brain images. The experimental results derived from CIELab color model can provide good segmentation performance with the proposed method and the location of a tumor or lesion can be exactly separated from the colored image. Thus the proposed method is more efficient and simpler since it is a combination of color translation, K-means clustering and histogram clustering.

III. METHODOLOGY

In this paper we propose collaborative techniques like Global Thresholding, Edge based segmentation, Histogram, and morphological feature extraction techniques combined with non parametric local transforms for detection of tumor. The flow of our work is articulated as shown below.

The input image is first acquired and it is first converted into grayscale image from RGB component because the DICOM reader would have read the image in RGB component. Next the gray scale image is converted into binary format for further processing because machined can understand 0's and 1's. Upon this image feature extraction methods like area, region of interest, histogram, boundary edge detection, centroid, mean, median and finally entropy to measure the randomness have been applied and the values are recorded. Finally 59 samples are chosen for training and 41 are chosen for testing. The classifier decides whether the input is benign or malignant based on the threshold values for which the images were qualified.

ISSN:2347-7385

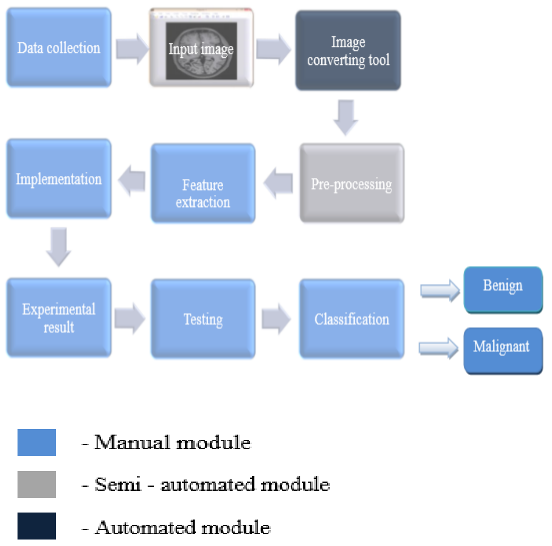

Fig 3.1: Block Diagram for Tumor Detection using MRImages

A. Input image: Input image is an MRI sample(T1,T2,FLAIR or ROI) of the form DICOM.
B. Image convertion tool: This tool is used convert the dicom image into a 'bmp' image format i.e '1.dcm' is converted into '1.bmp' as dicom formats are not suitable for processing and is not human readable.
C. Data collection: Data is collected from BRAININX, global data set containing around 30 samples each of T1, T2, Flair and ROI Images. Also a local dataset of T1,T2,FLAIR of a person is collected from HCG Hospital, Bangalore for experimentation.
D. Pre-processing: The data collected is converted into bmp format and it is resized appropriately for processing. On this segmented image further analysis is carried out. Finally, the obtained values are normalized and plotted under a common scale using histogram.
E. Feature extraction:
i) Mean: is calculated from summation of Matrix values used to represent a 2D image sample.
ii) Entropy to measure the randomness of image. Entropy = - Σ P(x) * (1 – log P(x))
iii) Size = size of image is calculated.
v) Centroid = ∑Matrix(i,j) / No of pixels
vi) Euclidian Distance = √(x-a) 2 +(y-b)2

F. Implementation: The implementation is carried out on OpenCV tool using the python as the parent programming language. Some packages like scipy and numpy have also been used with python3 for carrying out transformations on the images collected.
G. Results and Discussions: The experimentation is carried out for around 80 images and the results are tabulated for each of these T1, T2, FLAIR and ROI dataset image as shown in the table I.

H. Testing: The algorithm is tested on a 41 random images of T!,T2,FLAIR to check if the input image is defected or not and to find the error rate .
I. Classification: If the value is within the threshold range then the brain is malignant else brain is benign.
V. EXPERIMENTAL RESULTS
The experiment has been conducted on the data set collected from HCG hospital, Bangalore. A total of 59 images of T1,T2,FLAIR have been used for training the classifier. A sample output is shown below.

Fig : Original Image

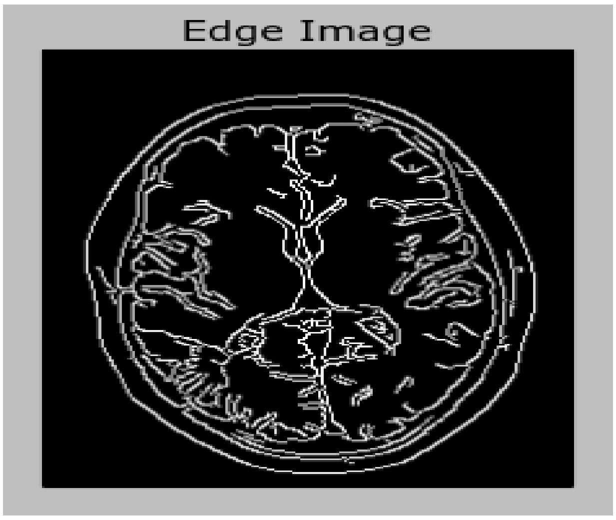

Fig : Edge Detection(Canny)

ISSN:2347-7385

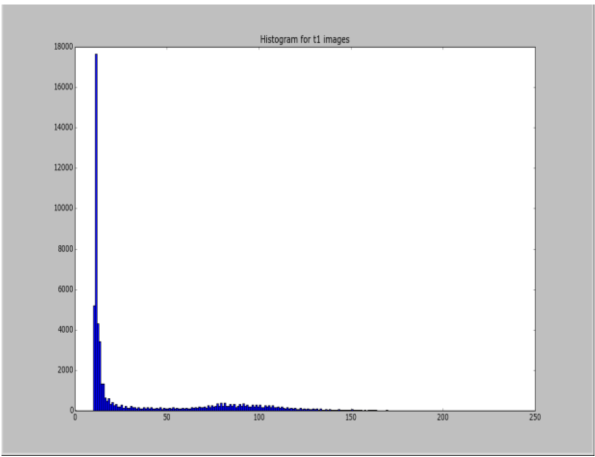

Fig: Original Image Histrogram

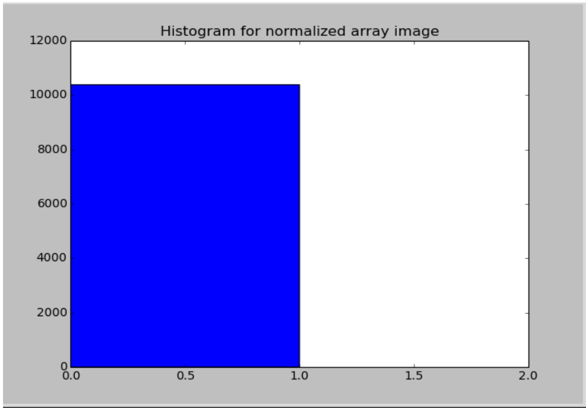

Fig : Normalized Image Histrogram

The performance of the experiment carried out on the datasets collected from T1, T2 and FLAIR respectively is tabulated below indicating the error rate as well.

Table 5.1 : Performance results

Samples	Accuracy in %	Error Rate in %
T1 (10 test samples)	50	50
T2 (10 test samples)	80	20
FLAIR(11 test samples)	100	NIL

V .CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we have identified the infected parts from the chosen data set of the brain by extracting the local feature area and histogram. From the above table 1, we conclude that the collaborative approach gives better accuracy for T2 and FLAIR but it gave only 50% accuracy for T1 dataset images. As a future enhancement we shall be using the non parametric collaborated feature extraction methods like range and census to identify the tumor effectively. In this work, we would like to improve the performance by applying some machine learning techniques like CNN and genetic algorithms. Also boost the performance of T1 images by using boosting algorithms like AdaBoost to reduce the error rate obtained.

VI. REFERNCES

[1] Ishmam Zabir, Sudip Paul, Md. Abu Rayhan, Tanmoy Sarker, Shaikh Anowarul Fattah, Celia Shahnaz "Automatic Brain Tumor Detection and Segmentation from Multi-Modal MRI Images Based on Region Growing and Level Set Evolution", IEEE International WIE Conference 2015.

[2]] Ruixuan Lang , Liya Zhao , Kebin Jia "Brain tumor image segmentation based on convolution neural network ", 9th International Congress on Image and Signal Processing 2016.

[3] Yuan Gao, Zhifeng Shi, Yuanyuan Wang, Jinhua Yu Liang Chen, Yi Guo, Qi Zhang, Ying Mao "Histological Grade and Type Classification of Glioma Using Magnetic Resonance Imaging" , 9th International Congress on Image and Signal Processing 2016.

[4] Prakash Tunga P, Vipula Singh " Extraction and Description of Tumour Region from the Brain MRI Image using Segmentation Techniques" IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, 2016, India.

[5] Parveen and Amritpal singh "Detection of Brain Tumor in MRI Images, using Combination of Fuzzy C-Means and SVM" 2nd International Conference on Signal Processing and Integrated Networks (SPIN) 2015.

[6] Swapnil R. Telrandhe, Amit Pimpalkar and Ankita Kendhe "Detection of Brain Tumor from MRI images by using Segmentation &SVM" World Conference on Futuristic Trends in Research and Innovation for Social Welfare (WCFTR'16) 2016.

[7] Ming-Ni Wu, Chia-Chen Lin and Chin-Chen Chang "Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation".