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A Reliable Method for Brain Tumor Detection Using Cnn Technique

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Abstract: *In modern days an efficient detection of brain tumor is being breathtaking challenge in medical field. An Automatic segmentation of brain images has a significant role in lessening the burden of manual labelling and increasing the strength of brain tumor diagnosis. Magnetic resonance imaging (MRI) has a high spatial resolution view of brain and it is a very powerful tool used to diagnose a wide range of disorders and proven to be a highly flexible imaging technique. This paper presents a reliable detection method based on CNN that reduces operators and errors. The Convolutional Neural Network (CNN) is used in convolving a signal or an image with kernels to obtain feature maps. The image processing techniques such as image conversion, feature extraction and histogram equalization have been developed for extraction of the tumor in the MRI images of the cancer affected patients. A suitable Fuzzy Classifier is developed to recognize healthier tissue from cancer tissue. The whole system is divided into two phases: firstly learning/Training Phase and secondly Recognition/Testing Phase. The aim of the project is to detect and extract the of tissue abnormalities by using the biochemical features. The specificity and the sensitivity of the method are evaluated and accuracy is determined. The performance parameters show significant outputs which are helpful in extracting tumor from brain MRI image.*

Keywords: *Brain tumor, Brain tumor segmentation, Convolutional Neural Network, Clustering Magnetic Resonance Imaging*

I. Introduction

Brain tumor is an unrestrained group of tissue may be implanted in the regions of the brain that makes the responsive functioning of the body to be disabled. Tumor can be divided into two types: benign and malignant tumors. Benign tumors are those which are able of spreading and affecting the other healthy brain tissue. Malignant tumors are typically grows outside of brain and called brain cancer. An image technique plays a central role in the diagnosis and treatment of brain tumor. Imaging of the tumors can be done by many ways such as Computed Tomography (CT) scan, Ultrasound and magnetic resonance image (MRI). Due to its non- invasive and soft tissues with high resolution MRI (Magnetic Resonance, MR) image has become an important diagnosis of brain tumors Tool. MRI image for a brain includes large amount of spatial information on brain structure and it can be utilized to medical diagnostics. Brain tumors are considered as one of the most deadly and difficult to identify and be treated forms of cancer. With the development of almost two decades, the pioneering approaches applying computer aided techniques for segmenting brain tumor are becoming more and more mature and coming closer to routine clinical applications.

Magnetic resonance (MR) [1] image segmentation of a brain is a very important and exigent task that is needed for the purpose of diagnosing brain tumors and other neurological diseases. Brain tumors have different characteristics such as size, shape, location, and image intensities. They may deform neighboring structures and if there is edema with the tumor, intensity properties of the nearby region change. An automatic segmentation of the brain MRI image is necessary because manual segmentation requires more time and can be subjected to errors. A fast reliable technique is necessary to detect the brain tumor because treatment planning is the key method to improve the survival period of oncological patients. This paper presents a reliable detection method based on CNN that reduces operators and errors. The Convolutional Neural Network (CNN) is used in convolving a signal or an image with kernels to obtain feature maps. The image processing techniques such as image conversion, feature extraction and histogram equalization have been developed for extraction of the tumor in the MRI images of the cancer affected patients. A suitable Fuzzy Classifier is developed to recognize healthier tissue from cancer tissue. The whole system is divided into two phases: firstly learning/Training Phase and secondly Recognition/Testing Phase. The detection of tumor takes place in main three main stages: (1) pre-processing (2) classification by CNN and (3) post-processing .The aim of the project is to detect and extract the of tissue abnormalities by using the biochemical features. The specificity and the sensitivity of the method are evaluated and accuracy is determined.

II. Previous Methods

Medical imaging segmentation is generally addressed in the modern as a classification problem where the previous methods can be divided into two main classes. The first class includes discriminative segmentation methods that are mainly based on image features and the training data. The second class contains generative methods which require additional information about the space domain. The accurate segmentation of tumors and its intra-tumoral structures is significant not only for treatment planning, but also for follow-up evaluations. The manual segmentation is time-consuming and subjected to inter- and intra-rater errors and makes difficult to characterize. Thus, physicians usually use rough measures for evaluation. For these reasons, accurate semi-automatic or automatic methods are required. It is a tough task, since the shape, structure, and location of these abnormalities are highly variable. Additionally, the tumor cells changes the arrangement of the surrounding normal tissues. Also, MRI images may contain some troubles, such as intensity in homogeneity or different intensity ranges among the same images and acquisition scanners.

Tumor growth models are used to know the effect of diseases, the area covered by the tumor and the grade of the tumor. Zhao et. al used MRF[2] to segment brain tumors. Generative models [3] well in unseen data but it may be difficult to explicitly generalize prior knowledge into appropriate probabilistic model. Classifiers such as SVM [4], [5] and RF [6] are successfully used in segmentation of tumor. On other hand deep learning methods are used for the segmentation by automatically learning an hierarchy of increasing complex features from data. The Self Organizing Map (SOM) [7], Principle Component Analysis (PCA) [8], Gradient Vector Flow (GVF) are some of the previous method used for the brain tumor segmentation and feature extraction

III. Proposed Method

The automatic detection method that developed here was composed of main three steps: (1) Pre-processing (2) classification via CNN and (3) Post-processing. Fig 1 represents the block diagram of the proposed system.

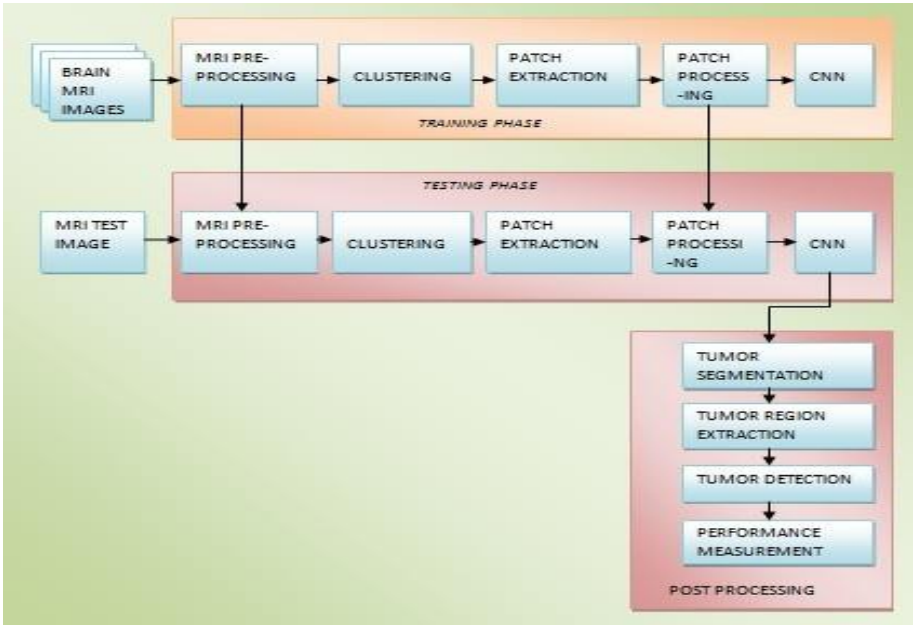

Fig 1: Proposed System

3.1 MRI Pre-Processing

The input MRI images required for brain tumor detection are processed to improve the accuracy of tumor detection. MR images are normally corrupted by bias field effect. This makes the intensity of the same tissues to vary across different reasons for the same MRI sequence. In order to make the contrast and intensity range similar we use intensity normalization method [9]. In this intensity normalization method a set of landmarks are learned for each images from training set. The bias correction is applied on the MRI images by linearly transforming the original intensities thus making the histogram of the each sequence more similar. The histogram of the bias corrected image and the original image is compared in order to ensure the accuracy of the following process.

3.2 Clustering

The clustering is a process of dividing different data samples into groups depending on how close their features are. The purpose of clustering is to identify natural grouping of data from large data set to produce a concise representation of a system's behavior. Fuzzy C means clustering [10] is used here. It is based on minimizing an objective function with respect to fuzzy membership. It starts with an initial guess for the cluster centre which is intended to mark the mean location. By iteratively updating the cluster centre and the membership grades of each data point, fcm iteratively moves the cluster centre to the right location within a dataset.

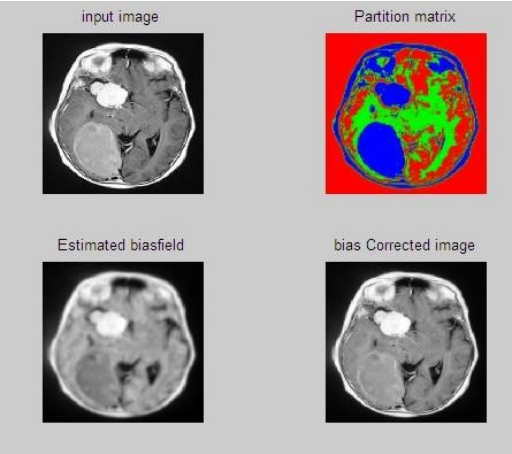

Fig 2: Images obtained after bias correction

3.3 Patch Extraction and Pre-Processing

The patches can be an edge, corner or a uniform texture of an image. The patch extraction is performed to identify the part that contains abnormalities. Patch pre-processing is done to compute the mean intensity value, standard deviation and the variance of the images at the training phase. The values obtained during the normalization process are stored as feature values which are used in the testing phase.

3.4 Convolutional Neural Network

Convolutional Neural Network [11] is made up of neurons that have learnable weights and biases. Each neuron receives some inputs. It performs a dot product and optionally follows it with a non-linearity. The ConvNet architectures make the explicit assumption that the inputs are images which allows us to encode certain properties into the architecture. A Convolutional Neural Network is comprised of one or more Convolutional layers often with a sub sampling step and then followed by one or more fully connected layers as in a standard multilayer neural network. The architecture of a CNN is designed to take advantage of the 2D structure of an input image.

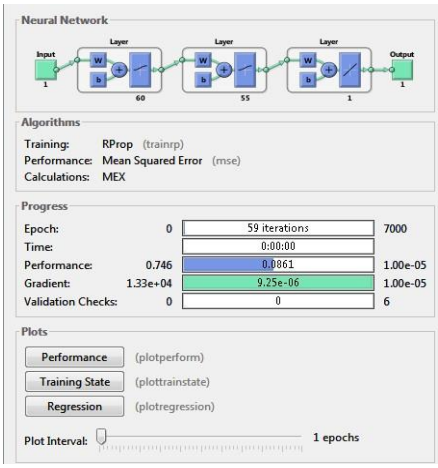

Fig 3: The Neural Network

Post-processing

Brain tu mors form a large connected region. So, the post-processing includes tumor segmentation, detection and extraction from the MRI images. It removes the smallest connected components. In this stage it detects the tumor alongwith the area covered by the disease.

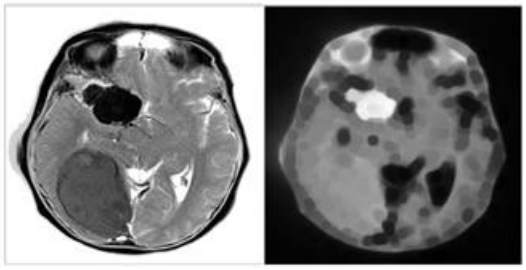

Fig 4: image obtained after CNN process

IV. Results

The developed system efficiently detects and extracts the tumor from the input MRI image of Brain Cancer affected patients. The MRI images of patients affected by Brain Cancer are used during Recognition/Testing phase. For the input image used for Testing, the system shows the Tumor Region Extracted from the outer skull of brain. The result in figure 2 shows the different images obtained during the Classification via CNN stages. The result in figure 2 shows the Tumor Region which is extracted from the MRI image and the area covered by the tumor. The performance parameters can be calculated through following mathematical expression:

Sensitivity = $TP / (TP + FN)*100$ (1)

Specificity = $TN / (TN + FP)*100$ (2)

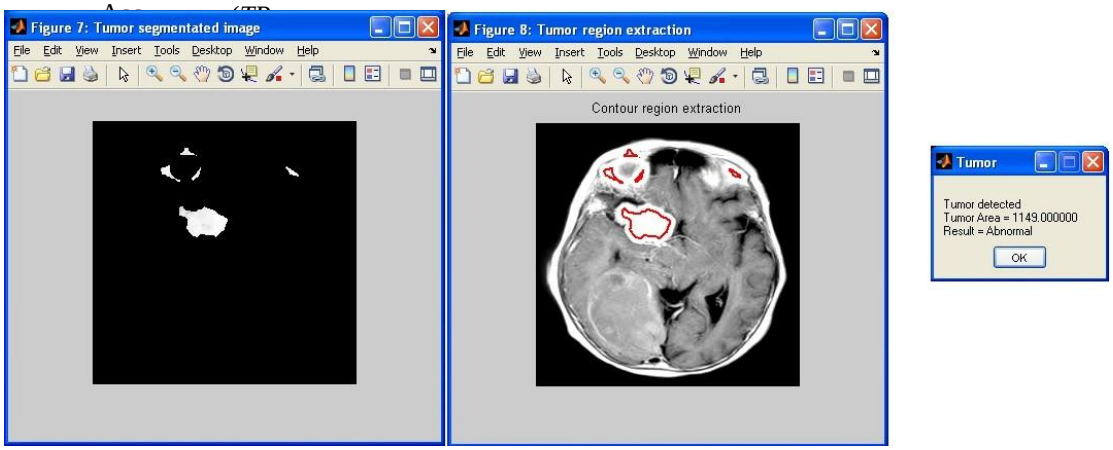

Fig 5

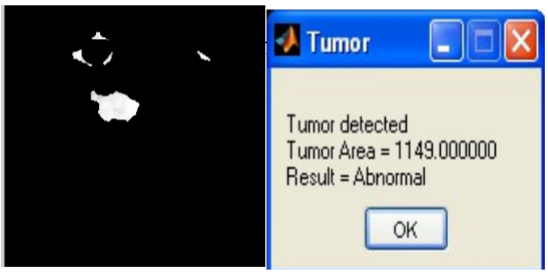

Fig 6: image showing the detected tumor and the area

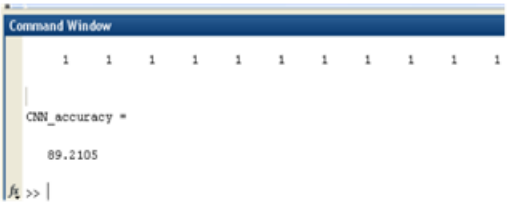

Fig 7: Image showing the accuracy of the system

V. Conclusion

The brain tumor detection is a great help for the physicians and a boon for the medical imaging and industries working on the production of CT scan and MRI imaging. The MR image segmentation is an important but inherently difficult problem in medical image processing. In general, it cannot be solved using straightforward, conventional image processing techniques. This paper aims at giving more information about brain tumor detection and extraction. The target area is segmented and the evaluation of the nature of the tumor using the tool suggested here helps the doctors in diagnosis the treatment plan making and state of the tumor monitoring. The advantages of this system are it improves the segmentation level and spatial localization of the image and also improves the efficiency compared to the other system. It consumes less time for computation and becomes easier to train with fewer parameters than other network. The accuracy of the system can be much more improved by using artificial neural network as the classifier.

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References

[1]. S. Bauer *et al.*, "*A survey of MRI-based medical image analysis for brain tumor studies*," *Phys. Med. Biol.*, vol. *58*, no. *13*, pp.97–129, 2013.

[2]. B. Menze *et al.*, "The *multimodal brain tumor image segmentation benchmark (BRATS*)," *IEEE Trans. Med. Imag.*, vol. *34*, no.10, pp. 1993–2024, Oct. 2015

[3]. B. H. Menze *et al.*, "A *generative model for brain tumor segmentation in multi-modal images*," in *Medical Image Computing and Comput.- Assisted Intervention-MICCAI 2010*. New York: Springer, 2010, pp. 151–159

[4]. S. Bauer, L.-P. Nolte, and M. Reyes, "Fully automatic segmentation of brain tumor images using support vector machine classification in combination with hierarchical conditional random field regularization," in *Medical Image Computing and Comput.-Assisted Intervention-MICCAI 2011*. New York: Springer, 2011, pp. 354–361.

[5]. C.-H. Lee *et al.*, "Segmenting brain tumors using pseudo-conditional random fields," in *Medical Image Computing and Comput.-Assisted*

[6]. *Intervention-MICCAI 2008*. New York: Springer, 2008, pp. 359–366

[7]. R. Meier *et al.*, "A hybrid model for multimodal brain tumor segmentation," in *Proc. NCI-MICCAI BRATS*, 2013, pp. 31–37.

[8]. Vinod Kumar, Jainy Sachdeva, Indra Gupta *" Classification of brain tumors using PCA-ANN"* 2011 World Congress on Information and Communication Technologies

[9]. Sergio Pereira, Adriano Pinto, Victor Alves, and Carlos A. Silva " *Brain Tumor Segmentation Using Convolutional Neural Networks in MRI Images"*IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 35, NO. 5, MAY 2016

[10]. Rasel Ahmmed, Md. Foisal Hossain "*Tumor Detection in Brain MRI Image Using Template based K-means and Fuzzy C-means Clustering Algorithm"* 2016 International Conference on Computer Communication and Informatics (*ICCCI* -2016), Jan. 07 –09, 2016, Coimbatore, INDIA

[11]. S.C. Turaga, J.F. Murray, V. Jain, F. Roth, M. Helmstaedter, K. Briggman,W. Denk, and H.S. Seung. Convolutional networks can learn to generate affinity graphs for image segmentation. Neural Computation, 22(2):511–538, 2010