EasyChair Preprint

№ 7317

Identification of Brain Tumor Type Using Deep CNN

Saranya Natarajan and S R Sowmiya

January 10, 2022

IDENTIFICATION OF BRAIN TUMOR TYPE USING DEEP CNN

Saranya.N[1],Sowmiya.S.R[2]

[1] ME-Computer Science and Engineering,Computer Science and Engineering,Dhanalakshmi Srinivasan Engineering College,Perambalur

[2] Head of the Department, Computer Science and Engineering,Dhanalakshmi Srinivasan Engineering College,Perambalur

[1] saranyacse99@gmail.com

[2] jitgiri10@gmail.com

Abstract

With the wide application of computer technology, medical health data has also increased dramatically, and data-driven medical big data analysis methods have emerged as the times require, providing assistance for intelligent identification of medical health. Traditional machine learning methods can't effectively mine the rich information contained in Brain tumor medical big data, while deep learning builds a hierarchical model by simulating the human brain. It is a deep learning method that extracts feature from the bottom to the top level from the original brain tumor medical image data. A data analysis model based on deep learning for brain tumor medical images was constructed and is used for intelligent identification and diagnosis of diseases and also provide recommendation and notification to patients through sms or email. The model uses massive brain tumor medical big data to select and optimize model parameters, and automatically learns the pathological analysis process of doctors or medical researchers through the model, and finally intelligently conducts disease judgment and effective decision based on the analysis results of brain tumor medical big data. In order to verify the validity of the proposed method for medical image data, this paper selects the brain MRI medical image data set as medical image data.

Keywords— ***Brain tumor, Deep Learning, diagnosis, pathological analysis, MRI medical image.***

Introduction

A brain tumor or intracranial neoplasm occurs when abnormal cells form within the brain. There are several ways to diagnose brain tumors, for example use MRI images. In MRI technique, brain is imaged on the basis of density of water in soft tissue which is higher compared to other tissues such as bone. Through the MRI images, the radiologist can see the brain anatomy without performing surgery. However, this process is still done manually and could lead to misdiagnose. In addition, the different complex characteristics of brain tumor make diagnosis more difficult. Therefore, system of Computer Aided Diagnostic (CAD) is indispensable that will help radiologist in identifying and classifying brain tumors. Magnetic Resonance Imaging (MRI) is a technique which is widely applied in the medical field. An MRI image gives better information for the treatment plan and brain tumor diagnosis. The imaging system is implicated for the determination of brain abnormalities accurately. CT scan gives the detailed pictures of the brain and examines the structure of the brain. MRI has no radiation and is very effective when compared to CT scan. The MRI or CT scan is used to examine the life structure of the brain. The MRI

detects the brain abnormalities by determining the location of the affected portion. The MRI is developed to give better properties of the different tissues and to creates high-quality images. The tumor is structured by the anomalous cell which is developed from the body tissues. Tumor specifies various biologic tissues; only a part of the MRI will not give the whole information about the anomalous tissues. The size, shape, and strength of the brain tumor vary and it makes the segmentation process more complex.

I. PROBLEM IDENTIFICATION

In manual segmentation, tumor areas are manually located on all contiguous slices in which the tumor is consider to exists. It is expensive, time consuming and tedious tasks. Convolutional neural networks are used for the evaluation of performance for automatic medical image segmentation. But ordinary CNN does not produce accurate and robust results for clinical use. To overcome this problem, we use Deep learning based iterative segmentation framework. This can be achieved by incorporating CNN in to a bound box and scribble-based segmentation. The CNN with bounding box can be either unsupervised or supervised and weight loss function is used for image tuning. In the testing stage, the user uses the bounding box. The BIFseg extracts the region inside the bounding box. The extracted region is then fed in to the pre-trained CNN for initial segmentation. This is how the CNN are designed and trained to observe some features such as saliency, contrasts and hyper intensity. Validation can be performed in two applications such as 2D segmentation of multiple organs and 3D segmentation of brain tumor. Experimental results shows that our model is more robust and provide better accuracy and it uses less time than traditional interactive segmentation methods. The main problem of this method is decrease in speed and accuracy. A DL model based on a convolutional neural network is proposed to classify different brain tumor types using two publicly available datasets. The former one classifies tumors into (meningioma, glioma, and pituitary tumor). The other one differentiates between the three glioma grades (Grade II, Grade III, and Grade IV).

II. METHODOLOGY

The proposed system is to A web browser-based interface is designed to be used by doctors, nurses and hospital administration staff, Patient – untrained in data science – to predict, forecast and recommendation System. Medical Big Data acquisition, as the basic step of Big Data process, aims to collect a large amount of data both in size and type by a variety of ways. To confirm data timeliness and reliability, implementing distributed platform-based high-speed and high-reliable data fetching or acquisition (extract) collection technologies are required to realize the high-speed data integration technology for data parsing, transforming and loading. MICCAI BRaTs is used to organizes a competition for brain tumor segmentation task. The dataset used during this study is BRaTs 2015. The dataset consists of 4 modalities of MRI data namely viz. T1, T2, T1c and air. the preprocessing step improves the standard of the brain tumor MR images and makes these images suited for future processing by clinical experts or imaging modalities. It also helps in improving parameters of MR images. The parameters include improvement in signal-to-noise ratio, enhancement in visual appearance of MR images, the removal of irrelevant noise and background of undesired parts, smoothing regions of inner part, maintaining relevant edges.

Median filter is used for less computation complexity and better smoothing of images. The median filter has two main advantages over the mean filter.

It is a more robust estimation than the mean. A single unrepresentative pixel in a neighborhood will not affect the median significantly.

It does not create new unrealistic pixel values, since the median must actually be the value of one of the pixels in the neighborhood.

The image is partitioned into different regions. Let an entire region of image be represented by S. Segmentation process can be viewed as partition of S into p sub regions like S1, S2, S3, …Sp. Certain conditions has to satisfied such as the segmentation must be intact; that is

each and every pixel should be within the region, every points in the regions should be connected in some sense, regions should be disjoint, etc.MR Image segmentation using region growing (RG) method. The region growing methodology and recent related work of region growing are described here. The features that extracted can be grouped into three categories. The first category is the first order statistics, that includes maximum intensity, minimum intensity, mean, median, 10th percentile, 90th percentile, standard deviation, variance of intensity value, energy, entropy, and others. These features characterize the gray level intensity of the tumor region. Deep Convolution Neural Network Classifier: The Deep Convolution Neural Network (CNN) classifier is used mainly for image and video recognition. The CNN is able for automatically learning the respective feature for data itself. The CNN follows few steps like receiving different inputs, calculating the sum of their weights, forward output to activation function and respond with the desired output. Based on CNN classification, the Brain MRI images important features like lines, edges, and object etc. complex features automatically able to identify with more accurately.

On prediction, the matching process is done with trained classified result and test MRI Classified file. Hamming Distance is used to calculate the difference according to the result the prediction accuracy will be displayed.

On recommendation system, developed a web-based prototype system. Hospital, Doctors, patients and researchers can operate the system using the following steps:

i. Input an MRI Bain tumor Image risk
ii. Confirm a risk level calculated by the system

The accuracy and the performance of the proposed system can be tested using confusion matrix. Outcomes of the prediction can be True Positive (TP), False Positive (FP), False Negative (FN), and True Negative (TN). In some cases, test says benign tumor, but it has malignant tumor, then it is False Negative (FN) and test says it is malignant tumor, but it has benign tumor, then it is False Positive (FP). The performance of the binary classification test has two major statistical measures in medical field and they are sensitivity and specificity.

Performance Measures Formula

- Accuracy =TP+TN/TP+TN+FP+FN
- Sensitivity=TP/TP+FN
- Specificity =TN/TN+FP

RESULT

The implementation of proposed model by using CNN method of multi type provides more efficiency than existing system of Ertosun et.al model by using CNN method of binary type.

MODEL	**BEST ACCURACY FOR STUDY 1**	**BEST ACCURACY FOR STUDY 2**	**CLASSIFI-CATION TYPE**	**CLASSIFI-CATION METHOD**
Cheng et al	91.28%	-	Multi	SVM and KNN
Paul et al	91.43%	-	Multi	CNN
Afshar et al	90.89%	-	Multi	CNN
Anaraki et al	94.2%	90.9%	Multi	GA-CNN
Zacharaki et al	-	85%	Multi	SVM and KNN
Zacharaki et al	-	88%	Binary	SVM and KNN
El-Dahshan et al	-	98%	Binary	ANN and KNN
Ertosun et al	-	71%	Multi	CNN
Ertosun et	-	96%	Binary	CNN

al				
Proposed structure	-	98.7%	Multi	CNN

Comparison of Type and Method

The comparison between the accuracy, classification type and method.

Features

- Deep Learning has been recently employed to solve various problems in computer vision and demonstrated state-of-the-art performance on visual recognition tasks. In medical imaging, especially in brain tumor cancer diagnosis and treatment plan development, accurate and reliable brain tumor segmentation plays a critical role.

- The DCNN method is able to segment the whole tumor (WT) region of the high-grade brain tumor gliomas using T1 Magnetic Resonance Images (MRI) and with excellent segmentation results.

CONCLUSION AND FUTURE ENHANCEMENT

`

Medical research that integrates Big Data will contribute to a higher level of human health at a broader and deeper level. Deep Learning has been recently employed to solve various problems in computer vision and demonstrated state- of-the-art performance on visual recognition tasks. In medical imaging, especially in brain tumor cancer diagnosis and treatment plan development, accurate and reliable brain tumor segmentation plays a critical role. Brain tumor segmentation using Deep Learning is described here. A 6-layer Dense Convolutional Network is constructed, that connects each layer to everysubsequent layer in a feed-forward fashion. This specific connectivity architecture ensures the maximum information flow between layers in the network and strengthens the feature propagation from layer to layer. This arrangement increases the efficiency during training and the accuracy of the results. Training and evaluation has been done based on the imaging data provided by the Multimodal Brain Tumor Image Segmentation Challenge (BRATS) 2019. The described method is able to segment the whole tumor (WT) region of the high-grade brain tumor gliomas using T1 Magnetic Resonance Images (MRI) and with excellent segmentation results. We will extend our work for various new algorithms for providing optimum results in context to existing techniques. Real-time application-based categorization will be one of the main factors in the selection of the technique. Diagnosing brain tumors is a complex and sensitive task, so preciseness and reliability will also play important role in the selection of the method.

REFERENCES

[1] Afshar. P, Plataniotis. K.N and Mohammadi. A, ‘‘Capsule networks for brain tumour classification based on MRI images and course tumour boundaries’’ 2018, arXiv:1811.00597. [Online].

[2] AnnisaWulandari, RiyantoSigit,MochamadMobedBachtiar et al., “Brain Tumor Segmentation to Calculate Percentage Tumor Using MRI” 2018.

[3] Behin. A, Hoang-Xuan.K, Carpentier. A. F, and Delattre J. Y, ‘‘Primary brain tumours in adults,’’ Lancet, vol. 361, no. 9354, pp. 323–331,2003.

[4] Bishop.C, Pattern Recognition and Machine Learning.Berlin, Germany: Springer-Verlag,2006.

[5] Brain, Other CNS and Intracranial TumoursStatistics.Accessed: May 2019.

[6] Bogowiczet al.M, “Post-radiochemotherapy PET radiomics in head and neck cancer—The influence of radiomics implementation on the reproducibility of local control tumor models” Radiotherapy Oncol., vol. 125, no. 3, pp. 385–391,2017.

[7] Chang S.G, Bin Yu, Vetterli.Met al., “Adaptive wavelet thresholding for image

denoising and compression '' Proc. IEEE, vol. 9, Sep. 2000.

[8] Chen Yu; Chen Dian-ren; Li Yang; Chen Lei et al., "Otsu's thresholding method based on gray level-gradient two-dimensional histogram" 2010.

[9] Deng. L and Yu. D, ''Deep learning: Methods and applications,'' Found. Trends Signal Process., vol. 7, nos. 3–4, pp. 197–387, Jun.2014.

[10] El-Dahshan. E. S. A, Hosny. T,and Salem. A. B. M, ''Hybrid techniquesforMRIbrainimagesclassificatio n,''Digit.SignalProcess.,vol. 20, pp. 433–441, Mar.2010.

[11] Goswami. S and Bhaiya. L.K.P, ''Brain tumour detection using unsupervisedlearningbased neural network,'' in Proc. Int. Conf. Commun. Syst. Netw. Technol. (CSNT), Apr. 2013, pp.573–577.

[12] Ioffe. S and Szegedy. C, ''Batch normalization: Accelerating deep network training by reducing internal covariate shift,'' 2015, arXiv:1502.03167. [Online].

[13] JemimmaT.A ,Jacob.YVetharaj et al., "Watershed Algorithm based DAPP features for Brain Tumor Segmentation and Classification" 2018.