AUTOMATIC DETECTION OF BRAIN TUMOR USING DEEP LEARNING ALGORITHMS

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Abstract

Brain tumor is an abnormal growth of cells which reproduce themselves in an uncontrolled manner. It is diagnosed through Magnetic Resonance Imaging (MRI) which plays an important role in segmenting a tumor region into different ways for surgical and medical planning assessments. But, manual detection may lead to errors, and it is a time-consuming process. To overcome the problem, experts use various algorithms for automatic detection of the tumor region which are based on Deep learning algorithms. They are designed to train and tune millions of images within a short period of time. Further, this paper proposes different types of classification methods with a number of iterations based on CNN architectures such as VggNet, GoogleNet and ResNet 50. For 60 iterations VggNet reports that 89.33% accuracy, GoogleNet 93.45% and ResNet 50 96.50%. Finally, it is proved that ResNet 50 achieves better results than VggNet and GoogleNet do in quicker time and with better accuracy.

Keywords: Deep Learning; Convolutional Neural Network; Magnetic Resonance Imaging.

I. INTRODUCTION

Human body is made up of several types of tissues and cells. Brain is a specialized organ that is often affected by tumor, like any other part of the body [1]. Brain tumor is an abnormal growth of tissues either in or around the brain often leading to death. It is very hard to find it at the beginning stage due to its irregular, shape, size, location, or appearances [2]. To identify these, it can be treated by medical diagnosis such as X-ray, Computed Tomography (CT) scan, Ultrasound, and Magnetic Resonance Imaging (MRI) [3]. These tools have the capability of exploring the structure of the cancer-affected region in the brain to help doctors in the diagnosis. And the treatment is planned based on the type (or) size of the tumor, which may be chemotherapy, radiotherapy or surgery. The MRI has a high-powered magnetic field component to regulate the frequency pulses to produces particular images of organs, bones, soft tissues and internal structures of the human body. This is an efficient method for the detection of tumor, and can be done through image-processing and several enhancement tools for identifying the quality of images. Then the threshold techniques and contrast adjustments are utilized for highlighting the MRI features.

In recent years, the Deep Learning algorithms are highly applicable in MRI images. It has the capability to train and fine-tune a large number of images for accurate results. Guotai Wang et.al proposed an interactive segmentation on MRI images using deep learning algorithms. The Gaussian Mixture Model (GMM) is used for pre-trained process which helps to improve segmentation accuracy. Also, the fine-tuning techniques are 2D and 3D CNN are widely used to avoid over-fitting [4].

Heba Mohsen et.al, suggests the classification of 66 MRI brain images using deep learning architectures. For accurate results the classifiers are combined with DWT (Discrete wavelet Transform) and PCA (Principal Component Analysis) are applicable for overall performance [5]. G. Litjens et.al, proposed the survey on deep learning concepts in various medical imaging techniques[6,7] like image classification, object detection, and lesion

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segmentation [8, 9]. A. Krizhevsky, I. Sutskeve et.al, contributes the different approaches of object recognition using machine learning algorithms. It consists of thousands fully-segmented images [10] and Image Net which consists of 15 million high-resolution images over 22,000 categories [11, 12]. N. Tajbakhsh et.al, proposed a pre-trained deep CNNs model from scratch images with sufficient fine-tuning process [13,14]. Further, [15, 16] suggests the early diagnosis of brain disease using deep learning algorithms. Based on that, this article proposes an automatic detection of brain tumor using deep learning algorithms such as VggNet, GoogleNet and ResNet 50 for accurate results.

II. PROPOSED METHODOLOGY

The proposed work is capable of automatic detection of brain tumor with different classifiers that are used for both structured and unstructured data. These classifiers help to divide data into a number of classes. These can be analysed through several classifiers like VggNet, GoogleNet and ResNet 50 as shown in fig.2.

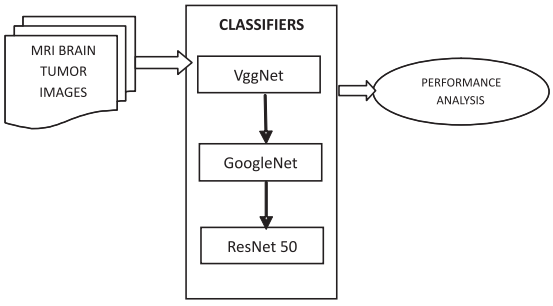

Fig 1 Block diagram of Brain Tumor using deep learning classifiers.

A. Vgg Net

VggNet comes under the classifiers of Convolutional Neural Network with 16 convolutional layers. At present it is a highly preferred classifier for feature extraction, and weight configuration is also available in VggNet. It has been designed for real time applications with 138 million parameters. It is a challenging method for handling millions of images during feature extraction.

B. Google Net

GoogleNet consists of 22 deep layers with an inception module. This module involves small convolutional layers to reduce the level of parameters. It has the ability to reduce the number of parameters and has an error rate of just 6.67%, which is far better than manual scrutiny. This network comes under the convolutional neural network, which has been inspired by Le Net. Further, it has the ability to achieve better results than the existing classifiers have.

C. ResNet 50

ResNet 50 is another classifier from convolutional neural network which consists of 50 deep layers. It is a pre-trained network that can be loaded with millions of images from the respective database (ImageNet). The pre-trained network can easily classify the images into different categories, such as keyboard, mouse, pencil and animals.

III. PERFORMANCE EVALUTION

The performance evaluations are calculated using accuracy of classifiers based on iterations and time consumption for training and testing MRI images.

Table I. Performance Evalution of Vgg Net, Google Net, Res Net 50

Classifiers	No. of. Iterations	Time Elapsed (in sec)	Accuracy (in %)
Vgg Net	10	35	60.00%
	50	85	75.35%
	60	102	89.33%
Google Net	10	30	51.20%
	50	70	88.15%
	60	85	93.45%
ResNet 50	10	25	53.74%
	50	50	87.16%
	60	72	96.50%

In Table. 1, for different number of iterations like 10, 50 and 60, Vgg Net gives an accuracy of 89.33% at 60 iterations. Google Net 51.20% to 93.45%, and Res Net 50 from 53.74% to 96.50%. These data from the table prove that Res Net 50 gives better accuracy than Vgg Net and Google Net do.

Table II. Overall Training and Testing of Classifiers

Classifiers	No. of. Iterations	Time taken for Training and Testing (in sec)	Overall accuracy (in %)
VggNet	60	102	89.33%
GoogleNet	60	85	93.45%
ResNet 50	60	72	96.50%

In Table. 2, the VggNet reports 89.33% accuracy with 60 iterations, GoogleNet 93.45% and ResNet 50 96.50%. Finally, it is proved that ResNet reports better accuracy than VggNet and GoogleNet do. Thus, the above tabulations are designed as bar graph with number of iterations vs accuracy.

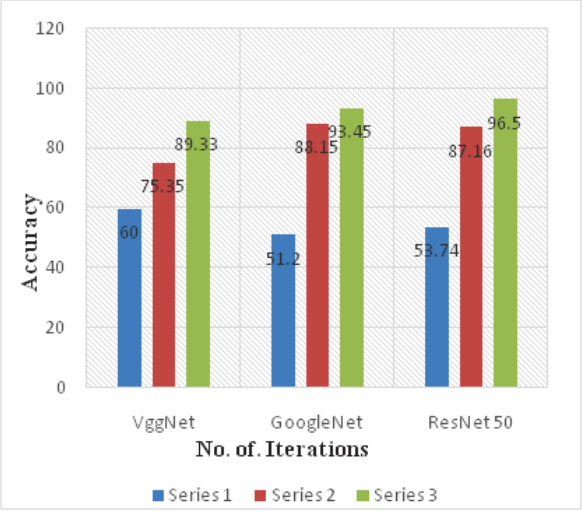

Fig. 2. Accuracy Plot of Vgg Net, Google Net, Res Net 50.

IV. CONCLUSION

Brain tumor is an abnormal growth of cells that reproduce in an uncontrolled manner. It is diagnosed through Magnetic Resonance Imaging (MRI) which plays an important role in segmenting a tumor region in different ways for surgical and medical planning assessments. In recent years, different diagnoses of MRI images are analysed through deep learning algorithms for more accurate results. Further, this article proposes different types of classification methods with a number of iterations based on CNN architectures such as VggNet, GoogleNet, ResNet. VggNet reports better accuracy at 89.33%, GoogleNet at 93.45% and ResNet at 96.50%. Finally, it is proved that ResNet 50 achieves 10% more accurate results than VggNet and GoogleNet do in quicker time and with better accuracy.

REFERENCES

[1] Akselrod Ballin, Karlinsky L, "A Region Based Convolutional Neural Network for Tumor Detection and Classification in Brain Tumor Analysis", IEEE Transactions on Computer Aided Network, Vol. 25, pp. 197–205, 2016.

[2] Chen L C, Papandreou G, Kokkinos I, Murphy A, "Deep Lab: Semantic image segmentation with deep convolutional nets, and fully connected CRFs", IEEE Transactions on Pattern Analysis, Vol. 40, No. 4, pp. 834-848, 2018.

[3] Dou Q, "3D deeply supervised network for automated segmentation of volumetric medical images", Medical imaging Analysis, Vol. 41, pp. 40–54, 2017.

[4] Guotai Wang, Maria A, "Interactive Medical Image Segmentation Using Deep Learning With Image-Specific Fine Tuning", International Transactions on Medical Imaging, Vol. 37, No 7, pp. 25-37, 2018.

[5] Heba Mohsen, El-Sayed A and El-Dahshan, "Classification using deep learning neural networks for brain tumors", Future Computing and International Journal (3), pp. 68-71, 2017.

[6] Thung K. H, "A robust deep model for improved classification of AD/MCI patients", IEEE Journal of Biomedical Health Information, Vol. 19, pp. 1610–1616, 2015.

[7] Justin Ker, Lipo Wang, "Deep Learning Classifiers Using MRI Brain Tumor Images", IEEE Transactions on Research in Computer and Communication Engineering, Vol. 2, No.2, pp. 73-76, 2017.

[8] Litjens G, Kooi T, Bejnordi, "A survey on deep learning in medical image analysis", Medical Image Analysis, Vol. 42, pp. 60–88, 2017.

[9] Li W, Wang G, Fidon L, Ourselin, "On the compactness, efficiency, and representation of 3D convolutional networks Brain percolation as a pretext task", International Journal in Medical image Processing, Vol. 49, pp. 348–360, 2017.

[10] Cai W, Pujol S, Kikinis R, "Early diagnosis of Alzheimer's disease with deep learning", IEEE 11th International Symposium on Biomedical Imaging, 2014.

[11] Krizhevsky A, Sutskeve, "Image Net Classification with deep Convolutional Neural Network", International Journal on Neural Information Analysis, Vol. 31, pp. 41-55, 2017.

[12] Shin H, "Deep Convolutional Neural Networks for Computer Aided Detection", IEEE Transactions on Medical Imaging Analysis, Vol. 35, No. 5, pp. 188-196, 2017.

[13] Rathore S, Shacklett A, and Davatzikos C, "A review on neuroimaging-based classification studies and associated feature extraction methods for Alzheimer's disease and its prodromal stages", Neuro Imaging, Vol. 155, pp. 530–548, 2017.

[14] Tajbakhsh N, "Convolutional Neural Network For Fine Tuning Medical Image Analysis", International Journal of Research in Engineering and Technology, Vol. 33, pp. 367-375, 2017.

[15] Zhang J, Adeli E, "Landmark-based deep multi instance learning for brain disease diagnosis", Medical Image Analysis, Vol. 43, pp. 157–168, 2018.

[16] Liu S, Pujol S, "Multimodal neuroimaging feature learning for multiclass diagnosis of Alzheimer's disease", IEEE Transaction, Vol. 62, pp. 1132–1140, 2015.