

Image Classification using Deep Learning Neural Networks for Brain Tumor

Prof. Shailaja Udtewar¹, Rohit Keshari², Kishan Gupta³

¹Professor, Dept. of Electronics and Telecommunication, Xavier Institute of Engineering, Mumbai, Maharashtra, India

^{2,3}Student, Department of Electronics and Telecommunication, Xavier Institute of Engineering, Mumbai, Maharashtra, India.

Abstract -The brain tumors, are the most common disease, leading to a very short life span in their highest grade. Among the various types of brain tumors, gliomas are the most common type, leading to a very short life. The survival rates of patients are improved if early diagnosis of brain tumor, Magnetic Resonance Imaging(MRI) is one of the non-invasive technique has emanated as a front-line diagnostic tool for brain tumor without ionizing radiation. In the clinical practice manual segmentation is highly depended on the operator's experience and its time consuming task. This paper consist of classification of brain tumor using convolutional neural network. Further, it uses high grade MRI brain image from kaggle database. The suggested work consist the classification of brain tumor and non brain tumor MRI images. The simulation results for the identification of human diseases show the feasibility and effectiveness of the proposed methods. The architecture are design by using small kernels. The weight of the neuron is given small. Experimental results shows 98.5 percent accuracy using CNN with low complexity and compared with the all other methods.

Key Words: Brain Tumor, MRI images, CNN, classification

1. INTRODUCTION

The brain is a main organ that controls the memory, emotion, sense, mind skills, vision, respiration, body temperature and immune system, and many other processes that regulate our body. The spinal cord is a large bundle of nerve fibers that extend from the base of the brain to the lower body. It carries messages to and from the brain and the rest of the body. Tumor is the unusual growth of the tissues. A brain tumor is a mass growth of abnormal cells in your brain. Many different types of brain tumors exist. Some brain tumors are non-cancerous and some brain tumors are cancerous. Brain tumors can

begin in your brain or cancer can begin in other parts of your body and spread to your brain. How quickly a brain tumor grows can vary greatly. The growth rate will determines how brain it will affect the function are affected in nervous system. Brain tumor treatment depend on the type of brain tumor as well as its size and location [1]. Brain tumor segmentation consists of extracting the tumor region from brain tissues; the existence of brain tumors can often be detectable. However, accurate and effective segmentation of tumors remains a challenging task, since the tumors can have different sizes and locations. Their structures are often non rigid and complex in shape and have various appearance properties. There intensities overlapping with normal brain tissues, especially in tumor borders; they show significant variable appearances from patient to patient. This paper is applying the deep learning concept to perform brain tumors classification using brain MRI images and measure its performance. The proposed methodology aims to differentiate between normal brain and brain tumors using brain MRI images[1].

2. LITERATURE SURVEY

Evaluation of Deep convolution Neural network for Automatic Identification of Malaria Infected Cells

In this proposed system the author make use of Deep learning for identification of malaria infected cells. Deep learning technology is used for deep classification accuracies of over 95 percent higher

than the accuracy of about 92 percent attainable by using svm Method. More advantage of deep learning technology are able to automatically learn the multiple layer features from input data for diagnosis. they used three well-known deep convolution neural network, including LeNet-5, AlexNet and GoogLeNet were used to learn the inherent features of the malaria infected cells and the non-infected cells. Dataset collected 1034 infected cells and 1531 non-infected cells. using that dataset they compile and simulated. The DIGITS software accelerated by up to four Nvidia Titan X GPUs were used for the neural network training. Goal of this method is to build a reliable and accurate automated detection system for malaria diagnosis[2].

Lung Pattern Classification for Interstitial Lung Diseases Using a Deep Convolutional Neural Network

A novel network architecture was designed that captures the low-level textural features of the lung tissue. The hole classification is done in 2D Manner. This network consist of 5 convolutional layers with 2x2 kernals, Leaky ReLU and followed by one average pooling. In this paper, a deep Convolutional neural networks is used to classify lung CT image patches into 7 classes including 6 Interstitial Lung Diseases (ILD) pattern and one healthy tissue. Training was performed by minimizing the categorical cross entropy with the Adam optimizer. The challenging dataset of 14696 image patches derived by 120 CT scans from different hospitals and scanners. DL approaches give the slight fluctuation of the results. Future plan to extend the method in 3D data from MDCT volume scans and finally integrate it into a CAD system for diagnosis of ILDs[3].

Brain Tumor Segmentation Using Convolutional Neural Networks in MRI Images

In this paper they have proposed a novel CNN-based method for segmentation of brain tumors in MRI images, BRATS 2012 and 2015 MRI brain tumor datasets are used for this proposed method. first they start by a pre-processing stage consisting of bias field correction, intensity and patch normalization. After that, during training, the number of training patches is artificially augmented by rotating the

training patches, and using samples of HGG to augment the number of rare LGG classes. The CNN is built over convolutional layers with small 3x3 kernels to allow deeper architectures, they have also compared the activation Relu and LRelu[4].

3. PROPOSED MODEL

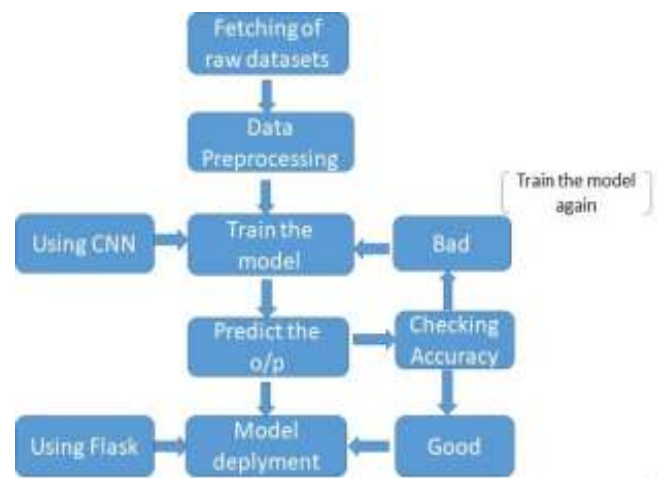


Fig. 1. Proposed mode

3.1. Dataset: The brain image and dataset is taken from kaggle. Kaggle is a platform made by google for predictive modelling and analytics competitions in which companies and researchers post data and statisticians and data miners compete to produce the best models for predicting and describing the data. Our dataset contains 253 images in which 155 MRI image of brain does not have while 98 images have tumor in the brain. If you want to train from the starting layer, we have to train the entire layer (i.e) up to ending layer. So time consumption is very high. It will affect the performance. To avoid this kind of problem, pre-trained model based brain dataset is used for classification steps. In the proposed CNN, we will train only last layer in python implementation. In the proposed CNN, we will train only last layer in python implementation.

The CNN based brain tumor classification is divided into three phases.

3.1.1. Training phase: In the training phase, preprocessing, feature extraction and classification with Loss function is performed to make the model. For the training of the model we separate around 80 percent images in the training folder. In the preprocessing is resizing of the image is applied to change size of the image. The number of images is divided into different category by using labels name such as tumor and non-tumor brain images, since our dataset is small so we are using data augmentation to increase the dataset for the training.

3.1.2. Testing phase: from the whole dataset we separate 20 percent of images for testing to avoid over fitting and after that similar steps are used which are used in the training phase.

3.1.3. Model deployment phase : After the training of the model we will check the accuracy, if the desired accuracy is obtained then we will deploy the model using flask on cloud

4. CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural network is a deep learning technique which is feed forward artificial neural networks that are applied to visual images. These are also called as CONV NETS. These are combined set of layers that can be worked on group functionalities.

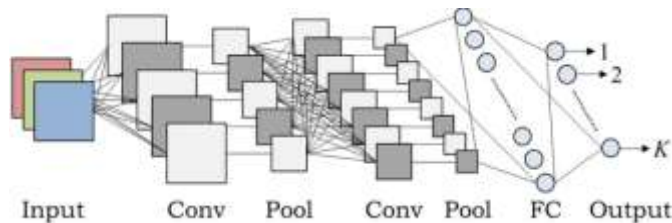


Fig. 2. CNN Architecture

CNNs have a different architecture than regular Neural Networks. Regular Neural Networks transform an input by putting it through a series of hidden layers. Every layer is made up of a set of neurons, where each layer is fully connected to all

neurons in the layer before. Finally, there is a last fully-connected layer the output layer that represent the predictions[5]. Convolutional Neural Networks are a bit different. First of all, the layers are organized in 3 dimensions: width, height and depth. Further, the neurons in one layer do not connect to all the neurons in the next layer but only to a small region of it. Lastly, the final output will be reduced to a single vector of probability scores, organized along the depth dimension.

CNN is composed of two major parts feature Extraction: In this, the neural network will perform a series of convolutions and pooling operations for the feature extraction from the image. Classification: in this part, the fully connected layers will serve as a classifier on top of these extracted features. They will assign a probability for the object on the image being what the algorithm predicts it is.

In cnn architecture are basically 4 steps are involved

4.1.1. Convolutional layers: In convolution layer various kernels are used for the extraction of feature. in this paper we used 64 of 3*3 kernels.

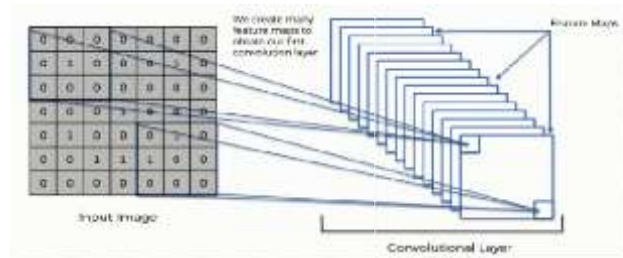


Fig.3.convolution output

Sharpening filters

0	-1	0
-1	4	-1
0	-1	0

Fig. 4. Sharpening filters

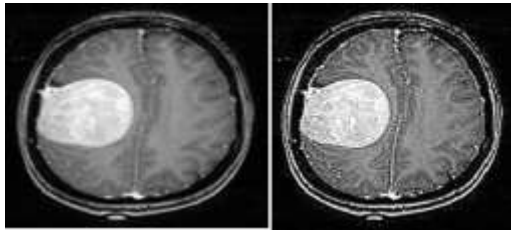


Fig. 5. Sharped image

After sliding our filter over the original image the output which we get is passed through another mathematical function which is called an activation function. The activation function usually used in most cases in CNN feature extraction is ReLU which stands for Rectified Linear Unit. Which simply converts all of the negative values to 0 and keeps the positive values the same.

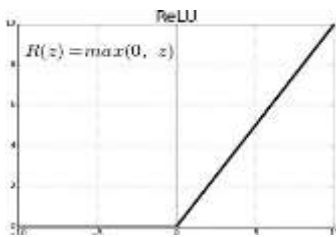


Fig. 6. Relu function

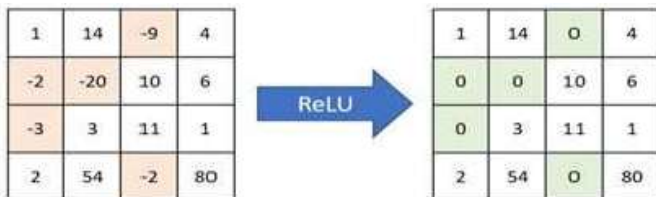


Fig.7 Relu

4.1.2. Max Pooling layers: The main idea of pooling is down- sampling in order to reduce the complexity for further layers. In the image processing domain, it can be considered as similar to reducing the resolution. Pooling does not affect the number of filters. Max-pooling is one of the most common types of pooling methods. It partitions the image to sub-region rectangles, and it only returns the maximum value of the inside of that sub-

region. One of the most common sizes used in max-pooling is 2x2 [6]

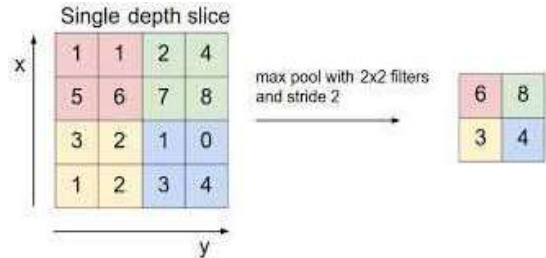


Fig. 8. Max Pooling

4.1.3. FLATTENING: In this step, all the pooled feature maps are taken and put into a single vector. The Flatten function flattens all the feature maps into a single column.

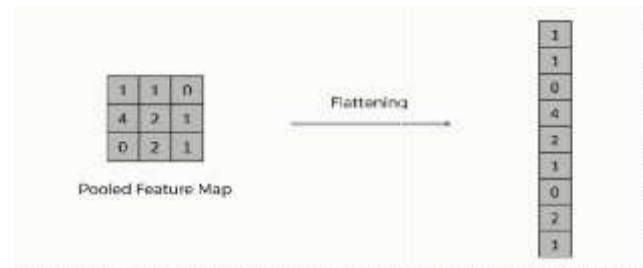


Fig. 9. Flattening

4.1.4. Fully connected layer: After flattening, the flattened feature map is passed through a neural network. This step is made up of the input layer, the fully connected layer, and the output layer. The fully connected layer is similar to the hidden layer in ANNs but in this case it's fully connected. The output layer is where we get the predicted classes. The information is passed through the network and the error of prediction is calculated. The error is then backpropagated through the system to improve the prediction [7].

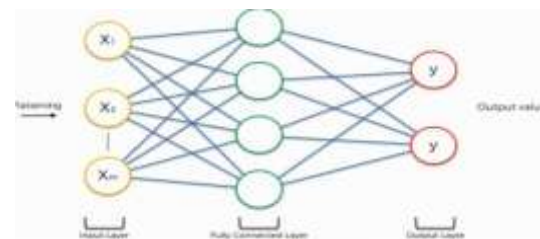


Fig. 10. Fully connected

5. RESULT

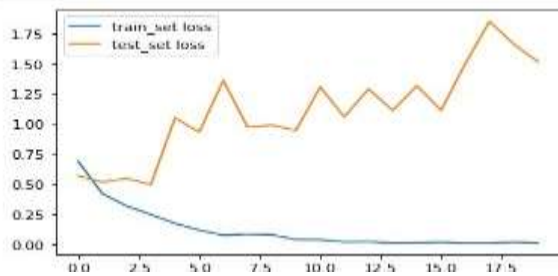


Fig. 11. Validation Loss

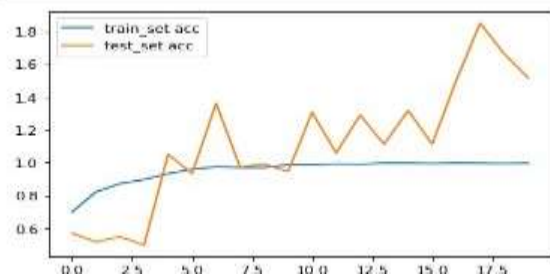


Fig. 12. Validation Accuracy

6. CONCLUSION

CNN is a very powerful algorithm which is widely used for image classification and object detection. The hierarchical structure and powerful feature extraction capabilities from an image makes CNN a very robust algorithm for various image and object recognition tasks.

7. ACKNOWLEDGE

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8. REFERENCES

[1] A. Bousselham, O. Bouattane, M. Youssfi, and A. Raihani, "Towards reinforced brain tumor segmentation on mri images based on temperature changes on pathologic area," International journal of biomedical imaging, vol. 2019, 2019.

[2] Y. Dong, Z. Jiang, H. Shen, W. D. Pan, L. A. Williams, V.V.Reddy, W. H. Benjamin, and A. W. Bryan, "Evaluations of deep convolutional neural networks for automatic identification of malaria infected cells," in 2017 IEEE EMBS International Conference on Biomedical Health Informatics(BHI) .IEEE,2017, pp.101-104.

[3]M. Anthimopoulos, S. Christodoulidis, L. Ebner, A. Christe, and S. Mougiakakou, "Lung pattern classification for interstitial lung diseases using a deep convolutional neural network," IEEE transactions on medical imaging, vol. 35, no. 5, pp. 1207-1216, 2016.

[4]S. Pereira, A. Pinto, V. Alves, and C. A. Silva, "Brain tumor segmentation using convolutional neural networks in mri images," IEEE transactions on medical imaging, vol. 35, no. 5, pp. 1240-1251, 2016.

[5]P. Lessons. (2019) Convolutional neural networks (cnn) explained step by step. [Online]. Available: <https://medium.com/analytics-vidhya/convolutional-neural-networks-cnn-explained-step-by-step-69137a54e5e7>

[6]S. Albawi, T. A. Mohammed, and S. Al-Zawi, "Understanding of a convolutional neural network," in 2017 International Conference on Engineering and Technology (ICET). IEEE, 2017, pp. 1-6

[7]D. Mwit. (2018) Convolutional neural networks: An intro tutorial. [Online]. Available: <https://heartbeat.fritz.ai/a-beginners-guide-to-convolutional-neural-networks-cnn-cf26c5ee17>