Project Title:

Brain Tumor Detection

[Comparison between CNN and Pre-trained Model]
[Based on MRI Images]

By:
Muhammad Owais Mushtaq [18K-1177]
Rethek Kumar [18k-0242]
Yougesh [18k-0290]

Introduction:

Problem Statement:

Brain tumors are the most destructive disease, leading to a very short life expectancy in their highest grade. The misdiagnosis of brain tumors will result in wrong medical intercession and reduce the chance of survival of patients. The accurate diagnosis of brain tumors is a key point to make proper treatment planning to cure and improve the existence of patients with brain tumor disease.

Solution:

The computer-aided tumor detection systems and convolutional neural networks provided success stories and have made important strides in the field of machine learning. The deep convolutional layers extract important and robust features automatically from the input space as compared to traditional predecessor neural network layers. Hence, we will firstly build a custom model through CNN and then we will build a pretrained model on the same dataset to also provide a comparison between models.

Motivation:

Brain tumor classification is an important problem in computer-aided diagnosis (CAD) for medical applications. Furthermore, resolving this issue has the potential to improve the chances of survival for a large number of patients because a correct assessment of a brain tumour is important for establishing a proper treatment plan to cure it. Therefore providing an application which can aid in and support a diagnosis can play a crucial role in Hospital and Patient's Life.

Related Work:

Numerous methods with solutions for identification of the brain tumor using MRI images had been proposed by a number of researchers in the past years. These methods vary from conventional machine learning algorithms to the deep learning models. In this regard, Cheng et al. [1] conducted an experiment on brain tumor dataset—Figshare. They used augmented tumor regions as regions of interest and split these regions into subregions by employing adaptive spatial division methods. They extracted intensity histogram, gray-level co-occurrence

matrix (GLCM), and bag-of-words (BoW) model-based features. They reported highest accuracy of 87.54%, 89.72%, and 91.28% on extracted features using ring-form partition method. Another contribution of the same authors was presented in [2]. They deployed Fisher Vector for the aggregation of local features from each subregion. Mean average precision (map) of 94.68% was retrieved. Similarly, Ismael and Abdel-Qader [3] extracted statistical features from MRI slices with the aid of 2D discrete wavelet transform (DWT) and Gabor filter techniques. They classified the brain tumors using back propagation multilayer perceptron neural networks and retrieved highest accuracy of 91.9%. Abir et al. [4] deployed a probabilistic neural network (PNN) for classification of brain tumors. They performed image filtering, sharpening, resize, and contrast enhancement in preprocessing and extracted GLCM features. They attained the highest accuracy of 83.33%.

Still the available automated tumor detection systems are not providing satisfactory output, and there is a big demand to get robust automated computer-aided diagnosis systems for brain tumor detection. The deep transfer learning-based techniques overcome these issues due extraction of visual and discriminative features using different convolutional layers automatically. These extracted features are supposed to be rich and robust for classification purposes.

Methodology:

Dataset:

For Dataset selection, we have used MRI images dataset which is available on Kaggle. However, the size of the dataset was not as large as any Deep Model requires for better training. Hence, we had used some data generation techniques such as Data Augmentation(Vertical Flip) to increase the data.

Model:

We have used CNN for our first choice for detecting Brain tumor in the Dataset of MRI images, we have used five Convolutional layers corresponding with RELU and Max Pooling (As shown in Fig.1) for feature learning then for feature detection we have used Dropout and flatten and dense layers. Lastly we have used sigmoid for binary classification.

For the Pre-Trained Model, we have used VGG16 which is a pre-trained Convolutional Neural Network which is 16 layers deep. For the final layer we have used sigmoid for binary classification, with adam optimiser to reach global minima.

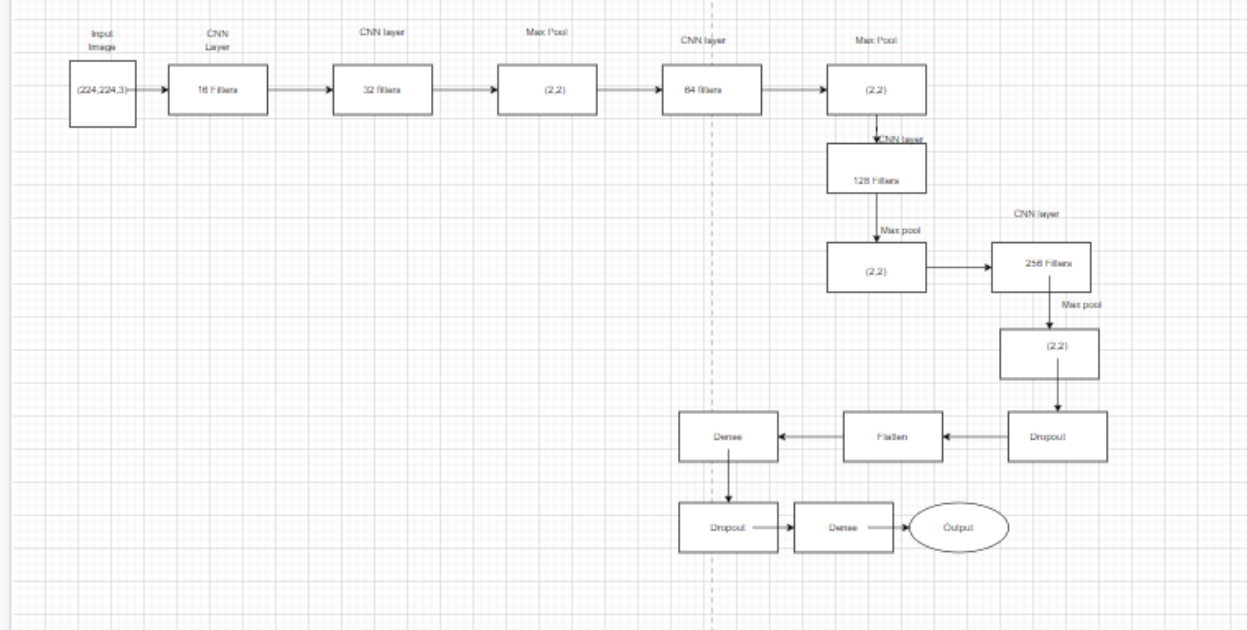

Fig.1 CNN architecture

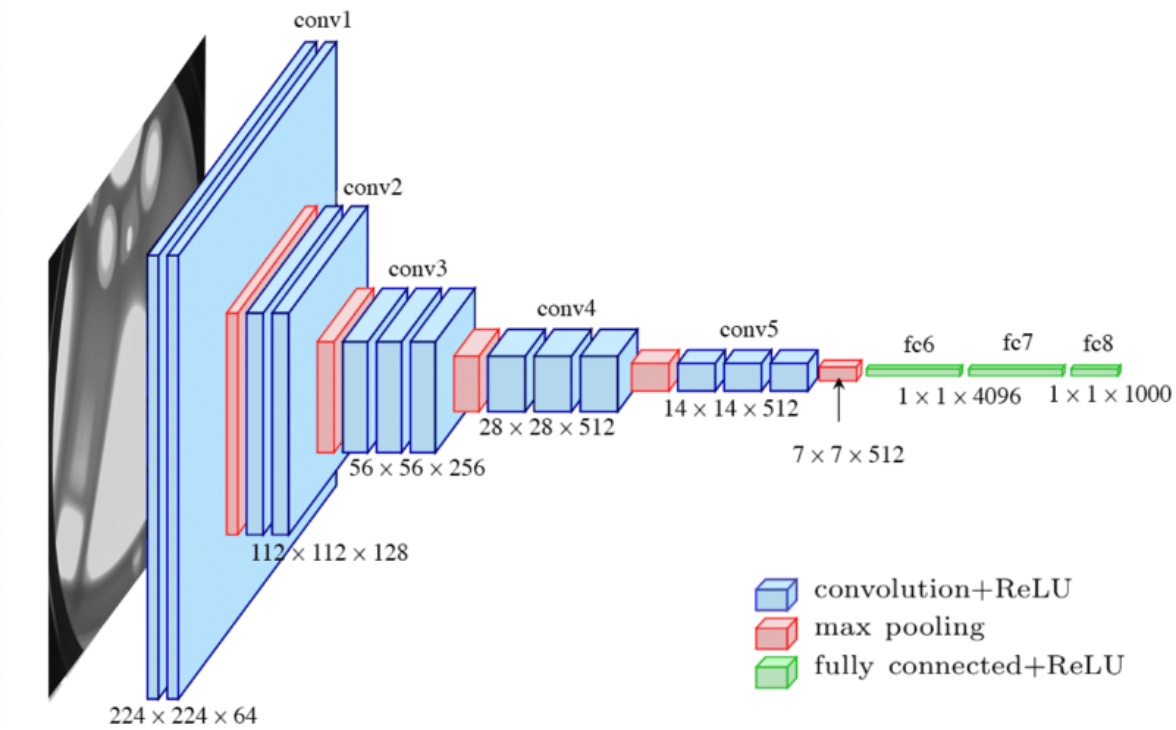

Fig.2 VGG16

Conclusion:

We have reached a conclusion through comparing the accuracy of both models trained on the same size of data that there is a 10% increase in accuracy in pre-trained models. The VGG16 pre-trained model turned out to be more efficient along with being more accurate.The Train/Test/Valid split Ratio for both models were kept the same at 70/15/15.

However, CNN model turned out to be pretty accurate and reliable and can be further improved over different tuning methods.In the end, VGG16 was simple to incorporate and provided 97.95% Accuracy on test data.Whereas,CNN Network stood at 89.16% accuracy.

References:

[1] J. Cheng, W. Huang, R. Shuangliang Cao, W.Y. Yang, Z. Yun, Z. Wang, Q. Feng, Enhanced performance of brain tumor classification via tumor region augmentation and partition. PLoS ONE **10**(10), e0140381 (2015)

[2] J. Cheng, W. Yang, M. Huang, W. Huang, J. Jiang, Y. Zhou, R. Yang, J. Zhao, Y. Feng, Q. Feng, Retrieval of brain tumors by adaptive spatial pooling and fisher vector representation. PLoS ONE **11**(6), e0157112 (2016)

[3] M.R. Ismael, I. Abdel-Qader, Brain tumor classification via statistical features and back-propagation neural network. In *2018 IEEE International Conference on Electro/Information Technology (EIT)*, pp. 0252–0257. IEEE (2018)

[4] T.A. Abir, J.A. Siraji, E. Ahmed, B. Khulna, Analysis of a novel MRI based brain tumour classification using probabilistic neural network (PNN). Int. J. Sci. Res. Sci. Eng. Technol. **4**(8), 65–79 (2018)

Dataset References:

[1] https://www.kaggle.com/navoneel/brain-mri-images-for-brain-tumor-detection

[2] https://www.kaggle.com/sartajbhuvaji/brain-tumor-classification-mri

[3] https://figshare.com/articles/dataset/brain_tumor_dataset/1512427