BRAIN TUMOR CLASSIFICATION USING CNN AND VGG16 MODEL

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ABSTRACT

Brain tumor is a collection, or mass ,of abnormal cells in brain. Detection of these tumor cells becomes challenging. Here, the Convolutional neural network will be used to classify the types of brain tumor. Till date, researchers have designed lots of brilliant deep convolutional neural networks(D-CNNs). However, most of the existing deep convolutional neural networks are trained with large datasets. It is quite rare for small datasets to take advantage of deep convolutional neural networks because of overfitting during implementation of those models. In this paper, we propose a modified deep neural network and use this model to fit a small size dataset. In this study, we propose a deep learning method which is used to classify Brain tumor types. Our method is based on VGG16 architecture with CNN as the classifier. We test our method using VGG16 dataset to measure the precision, recall, F-score and accuracy to evaluate our proposed method performance. The goal of our work is to show that a proper modified very deep model pre-trained on ImageNet for image classification can be used to fit very small dataset without severe overfitting.

Keyword : - *Neural Network, Convolutional Neural Netwok,VGG16*

1. INTRODUCTION:

Brain is one of the most vital organ of our body. It controls our actions and the functions of the body. It consists of more than 100 billion nerves that communicate with each other to perform day to day working of our body. Brain tumor is an abnormal growth of cells inside the brain or skull.

Brain tumor can be divided into two types: Benign Tumor and Malignant tumor. Benign tumor is non-cancerous tumor which does not spread in other parts of the body it is 1st stage tumor. Generally, benign tumors are less aggressive than malignant tumor. However, Malignant tumors are cancerous tumors which can spread in other parts of the body. They are the higher stages of brain tumor.

Brain tumor has led to millions of deaths in the world and has become a leading factor of deaths. So early detection of brain tumor is of utmost importance and now with the advancements in the field of medical science and technology, it is possible. Through Artificial Intelligence and Machine learning, softwares can be developed which can detect and also classify tumors into its various types. With the help of image processing and machine learning a brain tumor classification system is proposed through CNN and VGG16.

1.1Proposed System:

Convolutional Neural Network (CNN) is used to classify the data. VGG16 is a CNN model proposed for classification of dataset. Dataset is divided into three parts: training data, validation data and test data. Training data is used to train the model. The model uses the training images to train itself. Validation data is used to verify the training process and also determine the validation accuracy. The test data is used to determine the accuracy of the model, it is unknown data which is used to test the model.

Initially, a CNN model is developed and dataset is imported. Then the VGG16 model is considered and since the VGG16 is a pre-trained model, we use the weights of the VGG16 architecture in the CNN model. Then the accuracy and other parameters such as precision, recall and F1 score is calculated. Then the model is again trained by considering a few layers of the VGG16 architecture to improve accuracy.

1.2 Convolutional Neural Network

CNN is a deep learning algorithm which takes input image, assigns weights according to the features in the image and be able to differentiate one from another. CNN is used for image recognition, object classification and face recognition. Layers of CNN include Convolution layers with filters, pooling layers, fully connected layers. The block diagram of CNN is shown below:

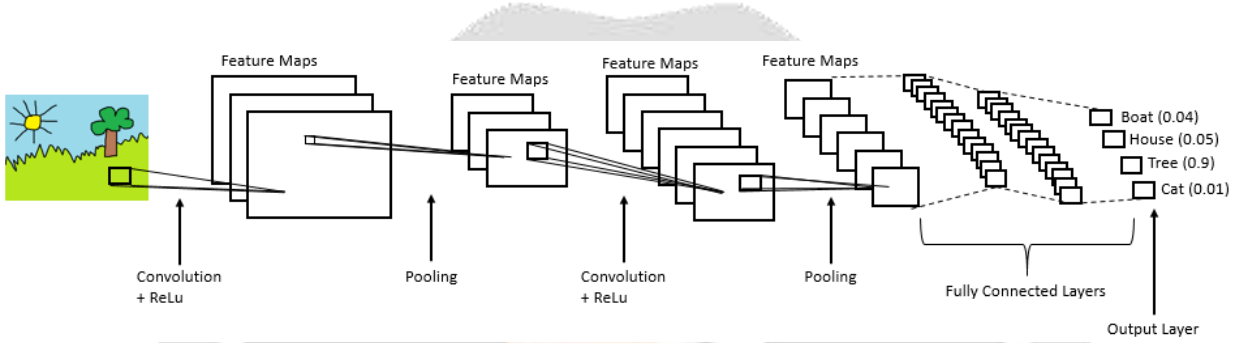

Fig. Architecture of Convolutional Neural Network

1.2.1 Layers of CNN:

1.2.1.1 Convolutional layer: The objective of the convolutional operation is to extract the features such as color, edges, gradient, orientation, etc. from input image. Feature maps are used to extract the important features of the image. It is basically a matrix multiplication of feature map and input image. This layer reduces the dimension of the input image.

1.2.1.2 Pooling layer: Similar to the convolutional layer, the pooling layer is used to reduce the dimension of the convolved feature. It is useful for extracting dominant features which are rotational and positional invariant. This helps in effective training of the model. There are two types of pooling: Max pooling and Average pooling. Max pooling returns the maximum value from the portion of the image covered by the kernel matrix. Whereas Average pooling returns the average of all the values.

1.2.1.3 Flattening: Flattening layer reduces the three- dimensional matrix into one dimensional matrix so that it can be easily given as an input to the next layer.

1.2.1.4 Fully connected layer: In this layer, all the inputs from one layer are connected to every activation unit of the next layer.

1.3 VGG16

VGG16 is a CNN model proposed by K. Simonan and A. Zisserman from the University of Oxford in the paper "Very Deep Convolutional Networks for Large-Scale Image Recognition." The model achieves 92.7% accuracy. This model used ImageNet, a dataset of over 14 million images belonging to over 1000 classes and over 22,000 categories. The architecture of VGG16 is shown in figure below:

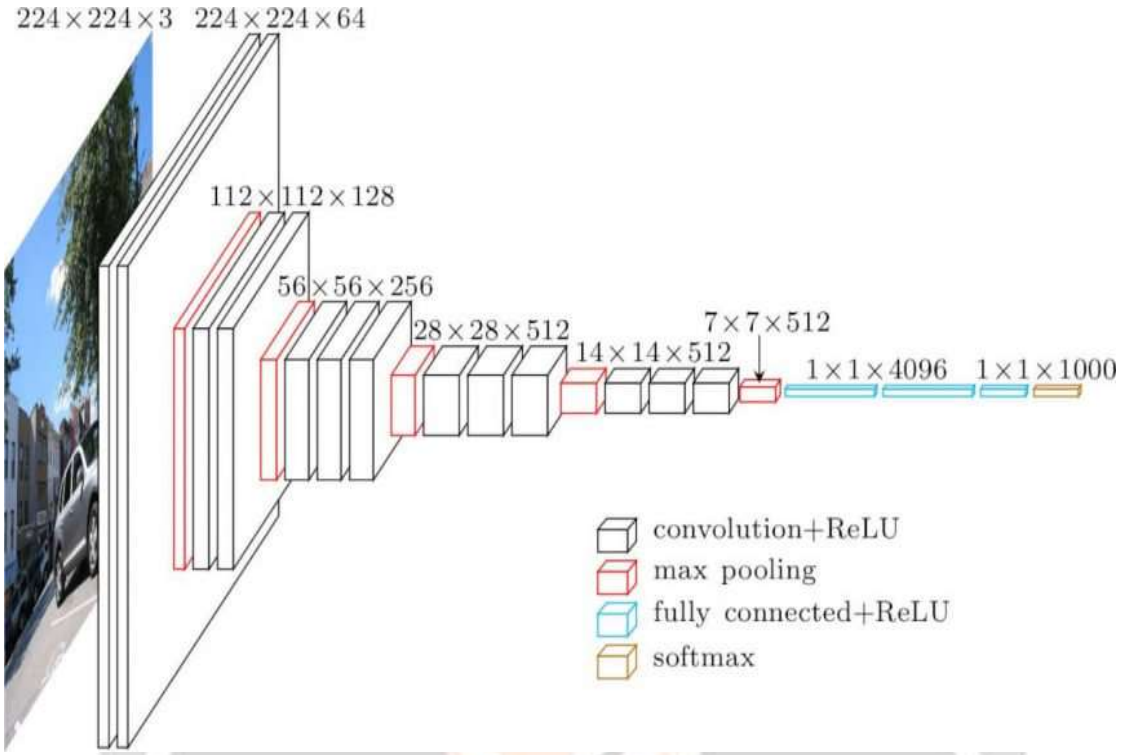

Fig. Architecture of VGG16

The ImageNet dataset consists of roughly 1.2 million training images, 50,000 validation images and 150,000 test images. Since this dataset consists of variable resolution images, all these images have been down-sampled to a fixed resolution of 256*256 patch. The input to the convolution layer is a RGB image of 224*224 patch. Then the image is passed through the convolutional and pooling layers. This is the basic architecture of VGG16.

Results:

Graphical representation:

The first figure show the comparison between training accuracy and validation accuracy. From the graphs, we can observe that both the accuracies are almost equal. This implies that our model is quite efficient.

The second figure shows the training and validation loss. It is observed that the training as well as validation loss is quite small.

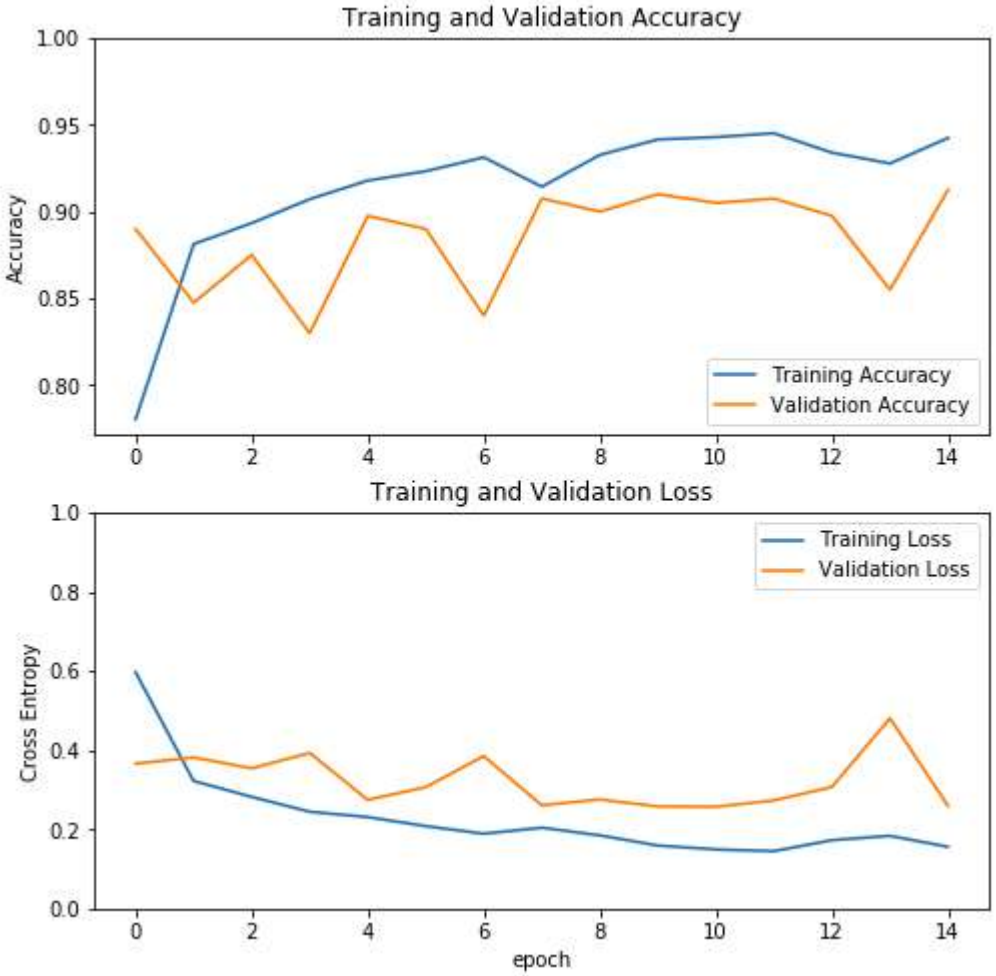

Fig.1 Comparison between training accuracy and validation accuracy
Fig.2 Comparison between training loss and validation loss

The below figure represents the training and validation parameters after again training the model. We can conclude that the accuracy has increased and the training loss is very negligible , it is almost zero.

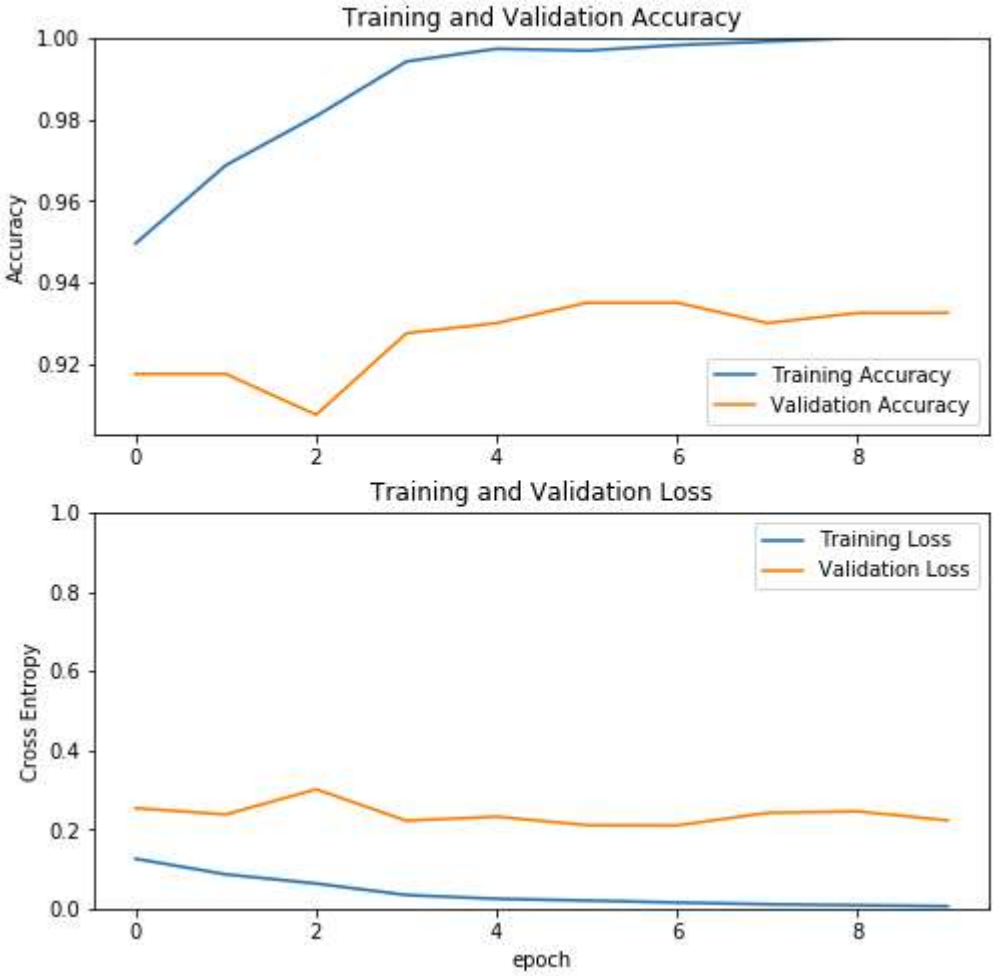

Fig.1 Comparison between training accuracy and validation accuracy
Fig.2 Comparison between training loss and validation loss

Confusion Matrix:

A confusion matrix is a table that is often used to describe the performance of a classification model. It data used for this matrix is the test data. The performance of the algorithm can be visualized through confusion matrix.

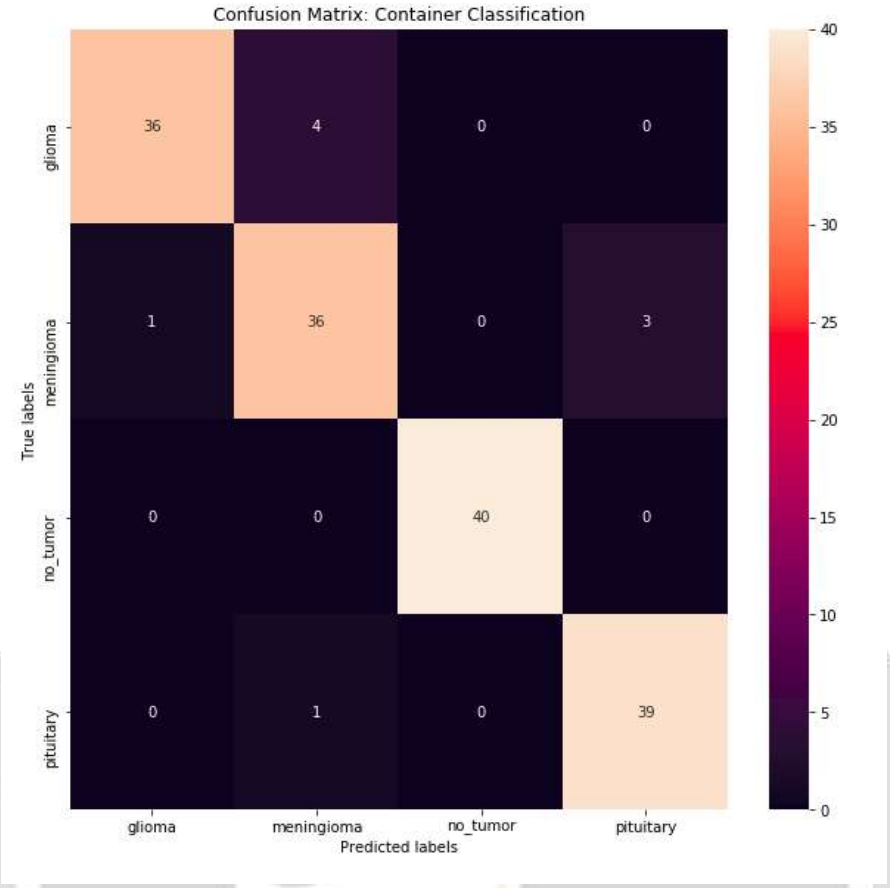

Fig. Confusion Matrix of the brain tumor classification model

4. CONCLUSIONS

In this study, a deep learning model is proposed for classifying tumors using CNN as a classifier. Based on our result, an accuracy of above 93% along with high precision, recall and F-score was achieved. Since, VGG16 is a pre-trained model and using its architecture was quite helpful for the CNN architecture. Using VGG16 as a pre-trained model was very helpful as it has a good performance for differentiating the types of tumor.

5. REFERENCES

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