Brain Tumor Classification from MRI Images using CNN with Extensive Data Augmentation

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Problem Statement

The presence of brain tumor among humans has increased in large amounts in recent years. Detecting and classifying brain tumor is a highly difficult task in early stages. For radiologists or clinical experts, the accuracy depends on their experience in classifying the tumor and also it consumes a lot of time. With the use of computer aided technology becomes very necessary to overcome these limitations.

The well-timed detection of the tumor can add to accurate treatment and can increase the survival rate of patients. For this reason, brain tumor classification is an important challenge for medical purposes. Currently several methods exist for tumor classification but they lack high accuracy. In this research, my goal is to improve the performance and reduce the complexity involves in the medical image classification process from MRI Images using CNN with extensive data augmentation.

Introduction

A brain tumor is an abnormal growth of tissue in the brain. They can lead to death if they are not detected early and accurately. Brain tumors can be cancerous (malignant) or noncancerous (benign).

There are 2 main types of brain tumors: Primary tumor and Secondary (metastatic) tumor.

The most common types of Primary Brain Tumors are Meningioma, Glioma, and Pituitary tumors. One of the tests to diagnose brain tumor is Magnetic Resonance Imaging (MRI). MRI scan is used because it is less harmful and more accurate than CT brain scan.The MR images are taken from three different directions. These views are called sagittal, axial and coronal. These three types of brain MR images are shown in fig1.

Introduction (cont.,)

Due to the large amount of brain tumor images that are currently being generated in the clinics, it is not possible for clinicians to manually annotate and segment these images in a reasonable time.

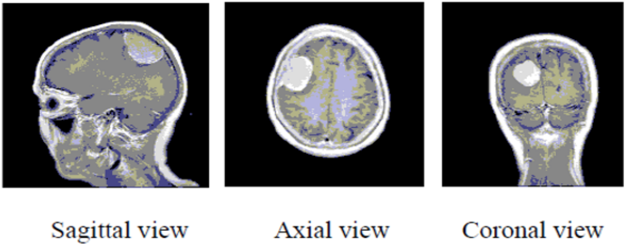


Figure 1: Brain MRI slices captured from different directions.

Dataset

This brain tumor dataset containing 3064 T1-weighted contrast-enhanced images from 233 patients with three kinds of brain tumor: meningioma (708 slices), glioma (1426 slices), and pituitary tumor (930 slices). This data is organized in matlab data format (.mat file). Each file stores a struct containing labels, image data, patient id for each image. The size of each image is 512x512. But there are some images whose sizes are varying. So I have resized all the images to a single size.

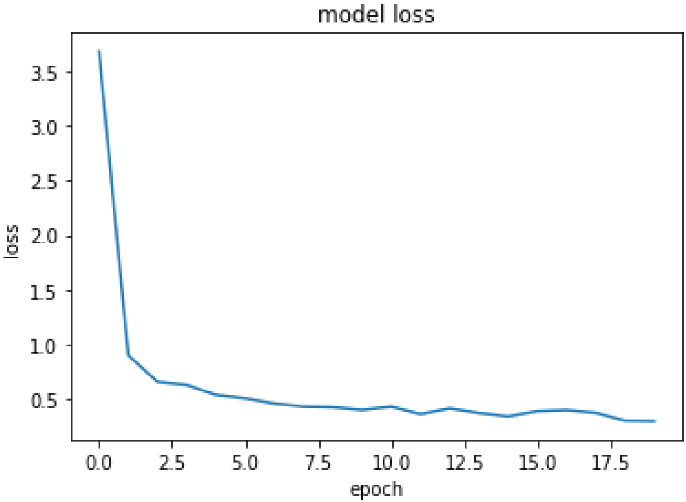
I have added a 4th class named as no tumor which consists of 98 images to the dataset.

Methodology

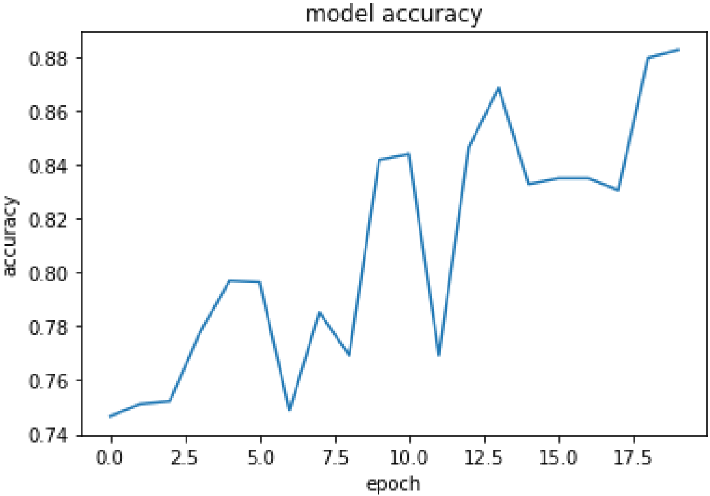
In this work, I have applied some of the various augmentation techniques to increase the size of training sets, to improve the network performance and to reduce overfitting. Some of the augmentation techniques are rotation, flipping and scaling.

I have used ResNet50 CNN architecture for classifying brain tumor by applying the method of Transfer Learning. I have trained the model for 22 epochs. At 20th epoch, I achieved the best accuracy. By using the best model, I achieved 87.8 percent of accuracy on test data.

Results


model loss
3.5
3.0
2.5
2.0
1.5
1.0
0.5
loss
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
epoch

Results


model accuracy
0.88
0.86
0.84
0.82
0.80
0.78
0.76
0.74
accuracy
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
epoch

Future work

- The results in models that have poor predictive performance, especially for the class no tumor because of data imbalance.
- I will apply regularization techniques so that the model generalizes better.
- Will try to extend augmentation techniques based on the computational complexity and memory limitations.
- Will try different CNN architectures to obtain better results.

THANK YOU