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

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Problem Statement

In the medical industry, misdiagnosis of disease is acknowledged as the most common and harmful medical errors as it can cost a human life. Particularly, 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.

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

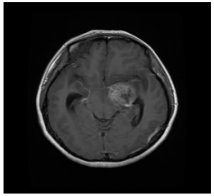
- A brain tumor is an abnormal growth of tissue in the brain.
- It can lead to death if they are not detected early and accurately.
- Brain tumors can be Malignant or Benign.
- Most common types of brain tumors are Meningioma, Glioma, and Pituitary tumors.
- One of the tests to diagnose brain tumor is Magnetic Resonance Imaging (MRI).

Dataset Description

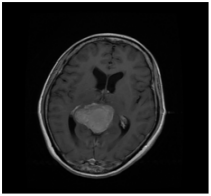
Two different publicly available MRI datasets are used in our work:

- The first dataset was obtained from Nanfang Hospital and General Hospital, Tianjing Medical University, China. The dataset contains 3064 T1-weighted CE-MRI images obtained from 233 patients with three kinds of brain tumor: meningioma (708 slices), glioma (1426 slices), and pituitary tumor (930 slices).
- The second dataset is collected from CASILab at the University of North Carolina at Chapel Hill and were distributed by the MIDAS Data Server at Kitware, Inc. The data available are from 20 healthy volunteers comprising MR brain images of 100 healthy subjects which were scanned per decade.

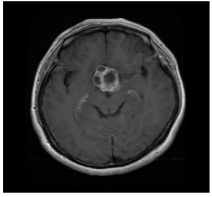
Dataset Description (cont.,)



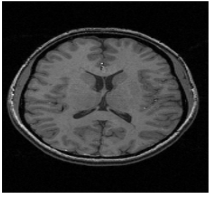
(a) Glioma



(b) Meningioma



(c) Pituitary



(d) Healthy (No Tumor)

Method

Using Transfer Learning:

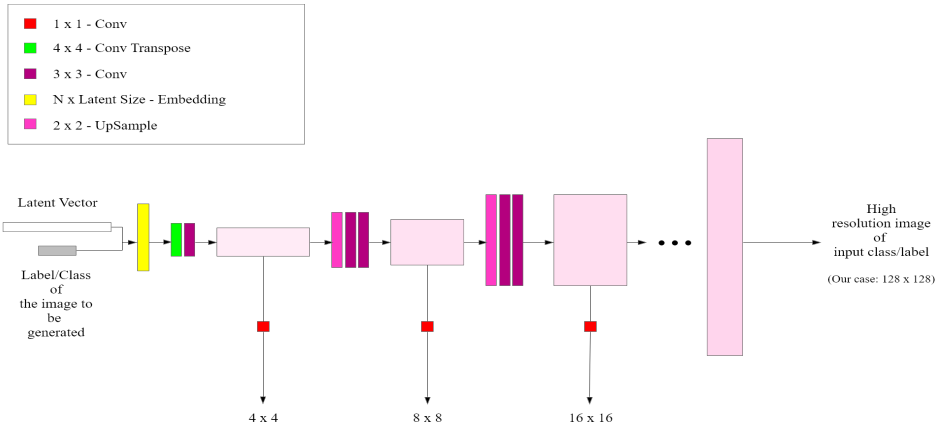
I have used ResNet50, VGG16, Inception V3, Xception pre-trained models for classifying brain tumor by applying the method of transfer learning. These models are trained as a whole (does not use ImageNet weights) using augmentations and without augmentations. The various augmentation techniques used are random rotation, centre crop and resizing.

Method (cont.,)

Using GAN as a pre-trained model:

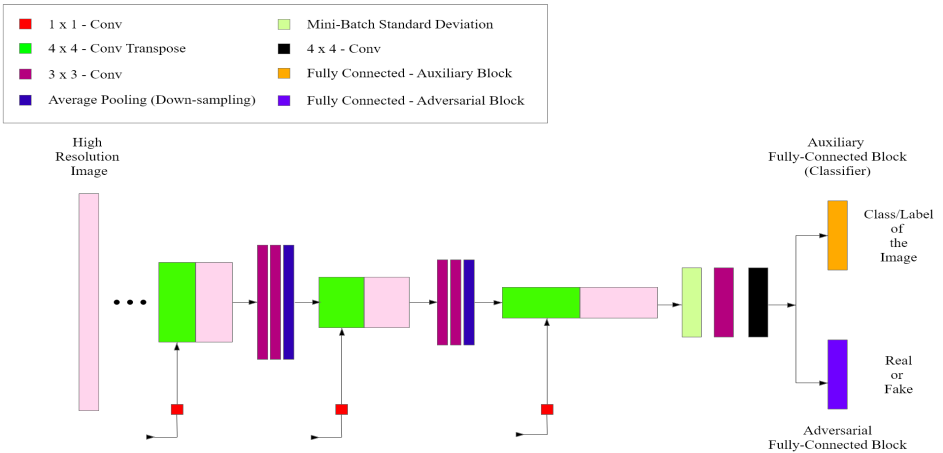
Here, we introduced a new deep learning approach for brain tumor classification on MRI Images. A deep neural network is pre-trained as a discriminator in a generative adversarial network (GAN) on MR Images by using multi-scale gradient GAN (MSGGAN) with auxiliary classification to extract the features and to classify the images. In the discriminator, one of the fully connected blocks acts as an auxiliary classifier and the other fully connected block acts as an adversarial. The fully connected layers of the auxiliary block are fine-tuned to classify the type of tumor. Angle augmentation with angles 45, 90, 120, 180, 270, 300, 330 was implemented for each image in the dataset alongside the original image, while training the GAN.

Method (cont.,)



Generator Architecture

Method (cont.,)



Discriminator Architecture

Results

Method	Without Augmentation[%]	With Augmentation[%]
Inception-V3	95.3	97.06
VGG16	92.8	95.07
ResNet50	93.7	96.63
Xception	98.53	**98.79**
GAN with CNN	-	**98.57**

Table: Classifiers method comparison

Results (cont.,)

Reference	Method	Best Accuracy[%]
Swati et al.	VGG19	94.82
Deepak et al.	GoogleNet	97.1
Proposed	Xception	**98.79**
Navid et al.	GAN + ConvNet	95.60
Proposed	GAN + ConvNet	**98.57**

Table: Comparison of the proposed approach with previous works

Conclusion

- Presented a new approach to classify brain tumors from MR Images using GAN as a pre-trained model, and also used some of the pre-trained models by applying the method of transfer learning with augmentations and without augmentations.
- Our results indicate that the proposed approach significantly improved overall efficiency and reduced overfitting.
- Also, this technique can be useful when the availability of data is limited and can be applied to various image classification tasks.

References

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*h*ttps://link.springer.com/chapter/10.1007%2F978-3-030-49161-1_17

Navid G

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*B*iomedical Signal Processing and Control, Volume 57, 101678, 2020.

Thank You