Brain Tumor Recognition using Machine Learning Techniques

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Introduction

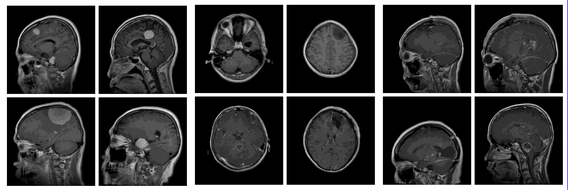
- Brain Tumors are the consequence of abnormal growth and uncontrolled cells division in the brain.
- Some types of Brain Tumors are Meningioma, Glioma, Pituitary, Lampoma and so on.
- One of the common method used to detect tumor in the brain is Magnetic Resonance Imaging(MRI).
- Recognition is the process of identifying the type of brain tumor from the MRI images.
- Tumor analysis is the challenging task for the doctors due to the complex structure of the human brain and high assortment in the appearance of cancerous tissues. But it is important where small error in judgment leads to death.
- There are many literature [1,2,3] on detecting these kinds of brain tumors and improving detection accuracies. Machine learning techniques play a major role in medical field. Convolutional Neural Networks (CNN) is an important deep learning technique for medical image classification.
- In this poster, we present two approaches that uses machine learning techniques for classifying brain tumors such as Meningioma, Glioma and Pituitary.

Dataset

To compare the performances of our proposed methodology

- Figshare brain tumor dataset [1] is used which contains 3064 T1- weighted contrast enhanced images.
- Each image having a dimension of 512 × 512 and images are available in mat format.
- It contains Tumor Image, Tumor Mask and Label.
- Dataset has Meningioma (708 slices), Glioma (1426 slices) and Pituitary tumor (930 slices).
- Slices are in 2D.

Sample images



Meningioma Glioma Pituitary

Methodology

Two different methodologies are proposed in this poster to recognize the brain tumors.

Proposed Methodology I

The following block diagram describes the stages in this proposed methodology.

Input(mat file)
Tumor image, Tumor mask, Tumor label

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Preprocessing
Extract Tumor region from image using tumor mask

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Feature Extraction(GLCM)
Extract 16 statistical features

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Feature Selection(Wrapper Method)
Select 11 Statistical Features

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Recognition
SVM, Decision Tree

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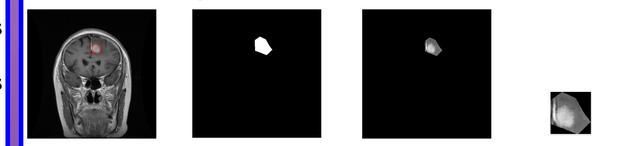
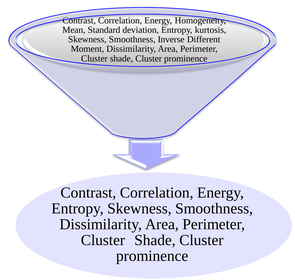
Output(Tumor Type)
1-Meningioma, 2-Glioma, 3-Pituitary

Preprocessing



Input Brain Image | Input Tumor Mask | Tumor region in the input brain image | Cropped region area for further process

Feature Selection



Proposed Methodology II

In this proposed approach, brain tumor area is extracted from the input images. Then, tumor area is resized into 512 × 512 pixels and considered as input. Then VGG-19 and ResNet-152 pre-trained Models are used for recognition.

VGG-19 Architecture

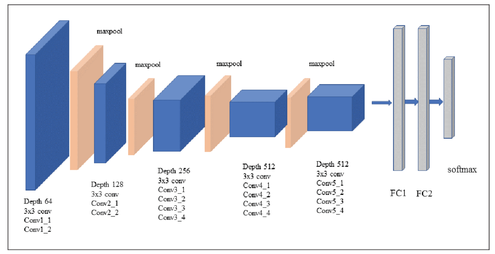
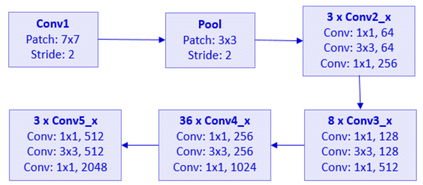


Fig. 3. VGG-19 network architecture

ResNet-152 Architecture



Experimental Setup

The following parameters are used in this experiment:

- Stochastic Gradient Descent (SGD) optimizer.
- Cross-entropy loss function.
- Batch size equal to 8.
- Initial learning rate 0.001.
- 30 epochs.
- 0.3 holdout partition method.

Conclusion and Future Work

- Classification of brain tumors plays an important role in medical imaging. The main purpose of this poster is to design an efficient brain tumor recognition system.
- Based on the testing results, SVM gives better classification rate than decision tree in the context of recognizing brain tumors. Also, CNN based proposed approach gives comparable classification rate with the state-of-the-art methods.
- Future work aims to develop an efficient brain tumor segmentation approach for 2D brain tumor images and evaluating this approach with larger dataset.

Result and Discussion

Several experiments are carried out in order to calculate the performance of our proposed methodologies. The detailed description of the experimental results are shown below.

Performance of SVM & Decision Tree

In this part, performances are evaluated without the feature selection method. 16 statistical features are considered for classification. SVM and Decision tree are involved during the classification process.

Model	Accuracy (%)
Decision tree	72.16
SVM with RBF kernel	73.50
SVM with Linear kernel	76.60
SVM with Polynomial kernel	**79.47**

Based on the accuracy, SVM with polynomial kernel gives highest accuracy than others.

Also, optimal features are selected using wrapper method and performance of the optimal features are calculated using SVM with Polynomial Kernel and it gives 80.54% as accuracy.

Comparison with State-of-the-art methods

The performances of our proposed methodology is compared with different state-of-the-art methods. The following table shows the performances of our method with other state-of-the-art methods.

Methods	Accuracy (%)
State-of-the-art methods	
Cheng J, et al (2015)	91.28
Badza M, et al (2020)	**96.56**
Han X, et al (2019)	93.33
Our method	
Proposed Methodology I	
Before Feature Selection	79.47
After Feature Selection	80.54
Proposed Methodology II	
using VGG-19 model	94.60
using ResNet-152	**94.67**

The proposed approach that uses ResNet-152 gives better classification rate than others including state-of-the-art methods. But, Badza M, et al developed their own CNN network which consists of 22 layers and the highest accuracy 96.56% was achieved in augmented dataset only.

References

1. Cheng, J., Huang, W., Cao, S., Yang, R., Yang, W., Yun, Z., Wang, Z., Feng, Q., ”Enhanced Performance of Brain Tumor Classification via Tumor Region Augmentation and Partition”, PloS one, 2015, vol. 10.
2. Badza, M., Barjaktarovic, M., ”Classification of Brain Tumors from MRI Images Using a Convolutional Neural Network”, Applied Sciences, 2020, no. 6: 1999.
3. Han, X., Zheng, H., Yiwen, Z., Guoli, S., ”Brain Tumor Recognition Based on Data Augmentation and Convolutional Neural Network”, International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS), 2019, pp. 291-296.