Multi-class brain tumor image classification using Transfer Learning

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Abstract

Brain tumor detection has received much attention due to the rapid increase in the number of cases. In general, abnormal growth of brain cells is called a brain tumor which impacts the quality of a patient's life. A brain tumor with cancerous cells is also known as a benign tumor and can become a life-threatening disease. The brain tumors are broadly segregated into two major grading levels: low-grade and high-grade. The low-grade tumors are mostly benign while high-grade tumors are malignant in nature. World Health Organization (WHO) the grading system including four grades depending nature of severity. Brain tumor grade classification is a challenging task in brain tumor image classification. Contemporary models have employed transfer learning to attain better performance. Transfer learning is a method of deep learning that is widely used to solve new problems through the exchange of knowledge. The semantic features of a tumor have ignored in the existing models during classification decisions.

An EfficientNet and multi-path convolution with a multi-head attention network for the grade classification. A multi-path convolution with multi-head attention network performs feature enhancement task. The features obtained from the above step have classified using a fully connected double dense network. A three-class (normal/ low-grade/ high-grade) grade classification dataset from the TCIA repository has considered for experiments. The proposed model has achieved a performance of 98.35%, and 97.32% in accuracy and jaccard coefficient, respectively. Further, it have achieved similar performance on a noisy dataset.

The contemporary research requires an optimized model to exhibit better performance on larger datasets. A mixed convolution based transfer learning with a support vector classifier model is proposed to address brain tumor grade classification. The proposed model utilizes a mixed convolution network for the enhancement of pre-trained EfficientNet features. The final classification results are produced using a linear support vector classifier to improve overall performance. Two publicly available datasets have utilized to perform two classification tasks including Task 1 (Grade 1/ Grade 2/ Grade 3) and Task 2 (Normal/ Low-grade/ High-grade). The proposed model attains the accuracy of 97.37% and 97.87% in Task 1 and Task 2, respectively. The proposed model attains similar results on noisy datasets and exhibits superior performance in vital metrics.