Paper Title: Brain Tumor Detection Using Convolutional Neural Network

Paper Link: https://sci-hub.se/https://ieeexplore.ieee.org/abstract/document/8934561

1. Summary

Brain Tumor and other nervous system cancer is the 10th leading cause of death according to the statistics of 2017 published by the Cancer Net Editorial Board. It has been proven that early detection of brain tumors can play an important role for medical personnel in treating cancer patients effectively. Unfortunately, early detection is limited by manual segmentations of tumors or lesions from MRI images, and it is time-consuming and labor-intensive. Brain tumors come in different shapes and sizes; it is difficult for a human to detect tumor cells from normal tissues; for this reason, classification of tumor regions from images is difficult for humans. On top of that, manual detection of cancer tumors can lead to ill-defined soft tissue boundaries. For all of the above reasons, it is pervasive and expensive to obtain accurate segmentation of tumors. To solve these challenges, this paper proposed a method to extract brain tumors from 2D MRI images. This paper showed performance analysis for Brain Tumor cell classification first using the Fuzzy C-Means clustering algorithm and then using six traditional classifiers, namely Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Multilayer Perceptron (MLP), Logistic Regression, Naive Bayes and Random Forest, finally performance analysis using Convolutional Neural Network (CNN). By appropriate experiment and analysis, they found that CCN performed better than traditional classifiers; the CCN gained a high accuracy of 97.87%.

1.1. Motivation

As Computer Hardware technology has become readily available, businesses and institutions worldwide are using dedicated graphical user interfaces (GPU) to carry out heavy computation tasks; these sophisticated hardware are used in large data centers to run heavy machine learning models to tackle different challenges, especially in the field of health and medicine. To better use this expensive hardware and for power-saving purposes, it is crucial to determine which algorithms are most suitable for each task. Thus, it is necessary for us to decide which algorithm, model, or approach we should use to classify brain cancer cells from 2D(MRI) images.

1.2. Contribution

Firstly, this paper made a general performance comparison by analyzing the accuracy of Fuzzy-C-Means, six traditional classifiers, and the Convolutional Neural Network (CNN). Secondly, this paper proposes a new method to identify regions of interest (ROI). Finally, they proposed two novel models that can do segmentation and detection of Brain tumors.

1.3. Methodology

The dataset used by the paper consists of MRI and CT scan images, and they applied two models to these datasets. The first model proposed by this paper segmented 2D (MRI) images using FCM. After that, they classified Brain cancer

cells using traditional machine learning algorithms, as stated earlier. This is done because segmentation by FCM gives better result when there are noise in the image data set. The second model proposed by this architecture is a modified Convolutional Neural Network (CNN); necessary tweaking was done to improve the performance for Brain cancer detection from 2D (MRI) image data.

1.4. Conclusion

In the field of medicine and healthcare, image segmentation plays a significant role because images consist of a large diversity. Right after a CT Scan, an MRI is the most common method of Brain cancer cell detection. In this paper, it has been shown that Fuzzy C-means clustering can be effective for tumor segmentation, which results in accurate cancer cell detection. This paper has also shown the performance of traditional classifiers such as K-Nearest Neighbour, Logistic Regression, Multilayer Perceptron, Naive Bayes, Random Forest, and Support vector machine on their diverse image dataset. The result showed that among the traditional classifiers, SVM gave the highest accuracy of 92.42%. Furthermore, their proposed CNN architecture improved the result by producing an accuracy of 97.87% while a split ratio of 80:20 was used.

2. Limitations

2.1. First Limitation

The study focuses on traditional classifiers and an improved CCN architecture, but it could not explore the performance of transformer-based approaches for classifying Brain cancer cells.

2.2. Second Limitation

This study explores the performance of the models talked about earlier on a dataset produced from the same source. A broader study is required on a hybrid dataset to suggest a specific model or approach that can be implemented by the healthcare industry.

3. Synthesis

Researchers worldwide are continuously finding new ways to implement deep learning and machine learning in the field of healthcare. All these techniques make use of pattern recognition, and this showed promising results; the proposed method architecture in the paper can be extended to handle more complex cancer cell classification as breakthroughs keep occurring in the field of computer vision. A thorough investigation must be done on multi-modal data by combining RGB data from colored MRI images. We can optimize the training process by manually drawing the region of interest (ROI) with the help of a certified doctor. Furthermore, more transformer-based models, such as vision transformers.