**Brain Tumor Detection Using Deep CNN**

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**Literature Survey**

**[1] Brain Tumor Detection and Classification Using Deep Learning and Sine-Cosine Fitness Grey Wolf Optimization**

**Abstract:**

Diagnosing a brain tumor takes a long time and relies heavily on the radiologist’s abilities and experience. The amount of data that must be handled has increased dramatically as the number of patients has increased, making old procedures both costly and ineffective. Many researchers investigated a variety of algorithms for detecting and classifying brain tumors that were both accurate and fast. Deep Learning (DL) approaches have recently been popular in developing automated systems capable of accurately diagnosing or segmenting brain tumors in less time. DL enables a pre-trained Convolutional Neural Network (CNN) model for medical images, specifically for classifying brain cancers. The proposed Brain Tumor Classification Model based on CNN (BCM-CNN) is a CNN hyperparameters optimization using an adaptive dynamic sine-cosine fitness grey wolf optimizer (ADSCFGWO) algorithm. There is an optimization of hyperparameters followed by a training model built with Inception-ResnetV2. The model employs commonly used pre-trained models (Inception-ResnetV2) to improve brain tumor diagnosis, and its output is a binary 0 or 1 (0: Normal, 1: Tumor). There are primarily two types of hyperparameters: (i) hyperparameters that determine the underlying network structure; (ii) a hyperparameter that is responsible for training the network. The ADSCFGWO algorithm draws from both the sine cosine and grey wolf algorithms in an adaptable framework that uses both algorithms’ strengths. The experimental results show that the BCM-CNN as a classifier achieved the best results due to the enhancement of the CNN’s performance by the CNN optimization’s hyperparameters. The BCM-CNN has achieved 99.98% accuracy with the BRaTS 2021 Task 1 dataset.

**Inference:**

The study proposed a Brain Tumor Classification Model (BCM-CNN) based on an advanced Convolutional Neural Network (CNN) architecture optimized using an adaptive dynamic sine-cosine fitness grey wolf optimizer (ADSCFGWO) algorithm. This model demonstrated exceptional performance in diagnosing brain tumors, achieving an impressive accuracy of 99.98% with the BRaTS 2021 Task 1 dataset. By leveraging the strengths of both the sine cosine and grey wolf algorithms, the ADSCFGWO algorithm effectively optimized the hyperparameters of the CNN model, resulting in superior classification outcomes. Furthermore, the study utilized a 3D U-Net segmentation model for tumor segmentation, enhancing the diagnostic capabilities of the proposed approach. Overall, the BCM-CNN model showcased significant potential in automating brain tumor diagnosis, offering a promising solution for efficient and accurate medical imaging analysis.

**[2] Accurate brain tumor detection using deep convolutional neural network**

**Abstract:**

Detection and Classification of a brain tumor is an important step to better understanding its mechanism. Magnetic Reasoning Imaging (MRI) is an experimental medical imaging technique that helps the radiologist find the tumor region. However, it is a time-consuming process and requires expertise to test the MRI images, manually. Nowadays, the advancement of Computer-assisted Diagnosis (CAD), machine learning, and deep learning in specific allow the radiologist to more reliably identify brain tumors. The traditional machine learning methods used to tackle this problem require a handcrafted feature for classification purposes. Whereas deep learning methods can be designed in a way to not require any handcrafted feature extraction while achieving accurate classification results. This paper proposes two deep-learning models to identify both binary (normal and abnormal) and multiclass (meningioma, glioma, and pituitary) brain tumors. We use two publicly available datasets that include 3064 and 152 MRI images, respectively. To build our models, we first apply a 23-layer convolution neural network (CNN) to the first dataset since there is a large number of MRI images for training purposes. However, when dealing with limited volumes of data, which is the case in the second dataset, our proposed “23-layer CNN” architecture faces an overfitting problem. To address this issue, we use transfer learning and combine VGG16 architecture along with the reflection of our proposed “23 layers CNN” architecture. Finally, we compare our proposed models with those reported in the literature. Our experimental results indicate that our models achieve up to 97.8% and 100% classification accuracy for our employed datasets, respectively, exceeding all other state-of-the-art models.

**Inference:**

The study presents a comprehensive approach to brain tumor detection and classification using deep learning techniques applied to MRI images. Traditional methods in this domain often rely on manual interpretation and expertise, which can be time-consuming and less reliable. Leveraging advancements in computer-assisted diagnosis (CAD) and deep learning, the paper proposes two models: a 23-layer convolutional neural network (CNN) and a fine-tuned VGG16 architecture. These models demonstrate remarkable accuracy in identifying both binary (normal vs. abnormal) and multiclass (meningioma, glioma, pituitary) brain tumors, outperforming previous state-of-the-art methods. By addressing challenges such as data imbalance and overfitting through techniques like data augmentation and transfer learning, the proposed models achieve classification accuracies of up to 97.8% and 100%, respectively, on two publicly available datasets. The study's methodology encompasses detailed data preprocessing, model architecture descriptions, and parameter optimization strategies. Overall, the results showcase the efficacy of the proposed approach in automating brain tumor detection and classification, thereby contributing significantly to the field of medical imaging and diagnosis.

**[3] A Deep Analysis of Brain Tumor Detection from MR Images Using Deep Learning Networks**

**Abstract:**

Creating machines that behave and work in a way similar to humans is the objective of artificial intelligence (AI). In addition to pattern recognition, planning, and problem-solving, computer activities with artificial intelligence include other activities. A group of algorithms called “deep learning” is used in machine learning. With the aid of magnetic resonance imaging (MRI), deep learning is utilized to create models for the detection and categorization of brain tumors. This allows for the quick and simple identification of brain tumors. Brain disorders are mostly the result of aberrant brain cell proliferation, which can harm the structure of the brain and ultimately result in malignant brain cancer. The early identification of brain tumors and the subsequent appropriate treatment may lower the death rate. In this study, we suggest a convolutional neural network (CNN) architecture for the efficient identification of brain tumors using MR images. This paper also discusses various models such as ResNet-50, VGG16, and Inception V3 and conducts a comparison between the proposed architecture and these models. To analyze the performance of the models, we considered different metrics such as the accuracy, recall, loss, and area under the curve (AUC). As a result of analyzing different models with our proposed model using these metrics, we concluded that the proposed model performed better than the others. Using a dataset of 3264 MR images, we found that the CNN model had an accuracy of 93.3%, an AUC of 98.43%, a recall of 91.19%, and a loss of 0.25. We may infer that the proposed model is reliable for the early detection of a variety of brain tumors after comparing it to the other models.

**Inference:**

The study focuses on the development and evaluation of a convolutional neural network (CNN) architecture for the early detection of brain tumors using magnetic resonance imaging (MRI) scans. By collecting a dataset of 3264 MRI images containing various types of brain tumors and employing pre-processing techniques and data augmentation methods, the study prepared the data for training. Through comparative analysis with other deep learning models like ResNet-50, VGG16, and Inception V3, the proposed CNN architecture demonstrated superior performance, achieving a validation accuracy of 93.3%, a validation AUC of 98.43%, and a validation loss of 0.25. These results underscore the efficacy of deep learning models, particularly the proposed CNN architecture, in accurately identifying brain tumors in MRI images, potentially advancing early detection methods and improving patient outcomes in clinical settings.

**[4] Brain tumor detection from MRI images using deep learning techniques**

**Abstract:**

Brain tumor is the growth of abnormal cells in brain some of which may leads to cancer. The usual method to detect brain tumor is Magnetic Resonance Imaging(MRI) scans. From the MRI images information about the abnormal tissue growth in the brain is identified. In various research papers, the detection of brain tumor is done by applying Machine Learning and Deep Learning algorithms. When these algorithms are applied on the MRI images the prediction of brain tumor is done very fast and a higher accuracy helps in providing the treatment to the patients. These prediction also helps the radiologist in making quick decisions. In the proposed work, a self defined Artificial Neural Network (ANN) and Convolution Neural Network (CNN) is applied in detecting the presence of brain tumor and their performance is analyzed.

**Inference:**

The study investigates the use of deep learning techniques to detect brain tumors from MRI images, focusing on Artificial Neural Networks (ANN) and Convolutional Neural Networks (CNN). By analyzing MRI scans, the goal is to accurately distinguish between normal brain tissue and tumor growth, aiding in timely diagnosis and treatment decisions. Results indicate that CNN outperforms ANN, achieving an impressive 89% accuracy on testing data. This highlights CNN's effectiveness in processing image data and providing precise results, showcasing its potential as a valuable tool for brain tumor detection. The research emphasizes the importance of deep learning in medical image analysis and suggests exploring optimization methods to further enhance model performance for broader clinical use.

**[5] Accurate detection of brain tumor using optimized feature selection based on deep learning techniques**

**Abstract:**

An unusual increase of nerves inside the brain, which disturbs the actual working of the brain, is called a brain tumor. It has led to the death of lots of lives. To save people from this disease timely detection and the right cure is the need of time. Finding of tumor-affected cells in the human brain is a cumbersome and time- consuming task. However, the accuracy and time required to detect brain tumors is a big challenge in the arena of image processing. This research paper proposes a novel, accurate and optimized system to detect brain tumors. The system follows the activities like, preprocessing, segmentation, feature extraction, optimization and detection. For preprocessing system uses a compound filter, which is a composition of Gaussian, mean and median filters. Threshold and histogram techniques are applied for image segmentation. Grey level co-occurrence matrix (GLCM) is used for feature extraction. The optimized convolution neural network (CNN) technique is applied here that uses whale optimization and grey wolf optimization for best feature selection. Detection of brain tumors is achieved through CNN classifier. This system compares its performance with another modern technique of optimization by using accuracy, precision and recall parameters and claims the supremacy of this work. This system is implemented in the Python programming language. The brain tumor detection accuracy of this optimized system has been measured at 98.9%.

**Inference:**

The presented research introduces a novel approach for brain tumor detection using an optimized Convolutional Neural Network (CNN) in conjunction with preprocessing, segmentation, and feature extraction techniques. By employing a compound filter for preprocessing and threshold-based segmentation, the system effectively enhances the quality of MRI images and isolates tumor-affected regions. Feature extraction utilizing the Grey Level Co-occurrence Matrix (GLCM) enables the characterization of tumor features, contributing to the accuracy of tumor detection. The optimized CNN, integrated with whale optimization and grey wolf optimization for feature selection, demonstrates superior performance compared to existing methods, achieving an impressive detection accuracy of 98.9%. This approach not only advances the field of medical image processing but also offers a promising tool for timely and accurate diagnosis of brain tumors, thereby facilitating improved patient outcomes and medical decision-making.

**[6] Brain tumor detection from images and comparison with transfer learning methods and 3-layer CNN**

**Abstract:**

Health is very important for human life. In particular, the health of the brain, which is the executive of the vital resource, is very important. Diagnosis for human health is provided by magnetic resonance imaging (MRI) devices, which help health decision makers in critical organs such as brain health. Images from these devices are a source of big data for artificial intelligence. This big data enables high performance in image processing classification problems, which is a subfield of artificial intelligence. In this study, we aim to classify brain tumors such as glioma, meningioma, and pituitary tumor from brain MR images. Convolutional Neural Network (CNN) and CNN-based inception-V3, EfficientNetB4, VGG19, transfer learning methods were used for classification. F-score, recall, imprinting and accuracy were used to evaluate these models. The best accuracy result was obtained with VGG16 with 98%, while the F-score value of the same transfer learning model was 97%, the Area Under the Curve (AUC) value was 99%, the recall value was 98%, and the precision value was 98%. CNN architecture and CNN-based transfer learning models are very important for human health in early diagnosis and rapid treatment of such diseases.

**Inference:**

The study focuses on using advanced deep learning methods, especially convolutional neural networks (CNNs), to identify different types of brain tumors from MRI scans. Among the models tested, VGG16 stands out with an impressive accuracy of 98%. Additionally, it achieves a high F-score of 97%, indicating a good balance between precision and recall. The Area Under the Curve (AUC) value, which helps assess model performance, reaches 99%, highlighting VGG16's effectiveness in accurately classifying brain tumors. These results emphasize the potential of CNN-based approaches, particularly VGG16, in improving the early detection and treatment of brain tumors. By harnessing state-of-the-art artificial intelligence techniques like deep learning and transfer learning, healthcare professionals can enhance diagnostic precision, accelerate treatment decisions, and ultimately enhance patient care. This research marks a significant advancement in leveraging technology to address complex medical issues, paving the way for more efficient and tailored healthcare solutions.

**[7] Brain Tumor Detection Using Convolutional Neural Network**

**Abstract:**

Brain Tumor segmentation is one of the most crucial and arduous tasks in the terrain of medical image processing as a human-assisted manual classification can result in inaccurate prediction and diagnosis. Moreover, it is an aggravating task when there is a large amount of data present to be assisted. Brain tumors have high diversity in appearance and there is a similarity between tumor and normal tissues and thus the extraction of tumor regions from images becomes unyielding. In this paper, we proposed a method to extract brain tumor from 2D Magnetic Resonance brain Images (MRI) by Fuzzy C-Means clustering algorithm which was followed by traditional classifiers and convolutional neural network. The experimental study was carried on a real-time dataset with diverse tumor sizes, locations, shapes, and different image intensities. In traditional classifier part, we applied six traditional classifiers namely Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Multilayer Perceptron (MLP), Logistic Regression, Naïve Bayes and Random Forest which was implemented in scikit-learn. Afterward, we moved on to Convolutional Neural Network (CNN) which is implemented using Keras and Tensorflow because it yields to a better performance than the traditional ones. In our work, CNN gained an accuracy of 97.87%, which is very compelling. The main aim of this paper is to distinguish between normal and abnormal pixels, based on texture based and statistical based features.

**Inference:**

The paper presents a comprehensive methodology for brain tumor detection using both traditional machine learning classifiers and Convolutional Neural Networks (CNNs). Through experimentation on MRI images from the BRATS dataset, the proposed CNN model achieved an impressive accuracy of 97.87%, outperforming traditional classifiers such as SVM, which achieved an accuracy of 92.42%. The study highlights the importance of accurate tumor segmentation and classification in medical image processing, emphasizing the potential of deep learning techniques like CNNs for achieving high-performance results. The authors also suggest future directions for research, including the exploration of 3D brain images and the development of country-specific datasets to further improve the accuracy and applicability of the proposed methodology. Overall, the findings contribute to the advancement of brain tumor detection methods, with potential implications for improving medical diagnosis and treatment planning.

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