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A Review on Classification of Brain Tumor by Deep Learning Using Convolutional Neural Network

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ABSTRACT

Brain tumors are classified using a biopsy, which is not normally done before conclusive brain surgery. The enhancement of this technology by ML could aid radiologists in tumor detection without the use of invasive procedures. The convolutional neural network is a ML-based algorithm that has achieved meaningful output and response in image segmentation and classification. Pattern and image recognition problems commonly employ convolutional neural networks (CNNs). Automatic brain tumor classification is a tough challenge because of the huge spatial and structural diversity of the brain tumor's encompassing area. Convolutional Neural Networks are capable of performing this function with simplicity. In this paper, we have performed a comparative study of different tumor classification methods using CNN.

Keywords — ML, tumor, Deep-learning, convolutionalneural network, image-classification, MRI imaging, Brain Tumor.

I. INTRODUCTION

The In the last decades as indicated by the World Health Organization, "Cancer or Malignant growth is the significant justification behind death internationally" [1]. As a general rule, mind growths are quite possibly the most widely recognized and forceful threatening cancer sickness, with a high mortality rate if diagnosed at a higher grade [2]. As a result, after detecting the tumor, brain tumor grading is a crucial step in determining a successful treatment strategy [3-4]. Meningioma, glioma, and pituitary tumors are the most common types of brain tumors depending on the affected region, and they are categorized as benign (noncancerous) and malignant (cancerous). Malignant tumors in the brain may quickly spread to other brain tissues, deteriorating the patient's condition [5]. Brain tumors are classified according to their position, type of tissues involved, whether they are cancerous or non-cancerous, Origination place, such as primary or secondary and so on. According to the World Health Organization, there are 200 distinct types of brain tumors based on cell origin and cell activity, ranging from mild to aggressive [1]. Tumors are also divided into benign and malignant. Due to the obvious shape, size, position, and condition of tumor in the brain, its identification is extremely difficult. It is difficult to detect brain tumors at the beginning of their forming because it is impossible to reliably determine the tumor's size and resolution [6]. If a tumor is identified and cure at the beginning of the tumor development process, the probability of a patient being treated is very high. As a result, timely tumor diagnosis is important for effective treatment [7]. A medical examination, as well as computer tomography or magnetic imaging, are usually used to make the diagnosis [8]. One of the primary and important techniques for detecting and evaluating the patient's brain is MRI imaging, which produces accurate images of the brain. Due to their higher dissimilitude in mushy tissue in persons, MRI pictures give improved results than other imaging strategies like CT in the field of clinical discovery frameworks [9]. Many artificial intelligence technologies have recently been used to identify and recognize brain tumors, including SVM, ANN, CNN [10-14]. CNN is perhaps the most recent innovation and advanced in the machine learning domain, and it is utilized in the analysis of infections utilizing clinical pictures, explicitly CT and MRI pictures. Since it does not require pre- processing or feature extraction before the training process, CNN has recently become useful in clinical pictures categorization and grading [15-16]. By and large, CNNs are utilized to manage crude pictures and are intended to dispose of or counterbalance a portion of the information pre-handling steps. The input layer, convolution layer, RELU layer, totally associated layer, order layer, and result layer are among the few piled layers that make up CNN. The process of CNN comprises of two cycles: the convolution, and the down inspecting [17].

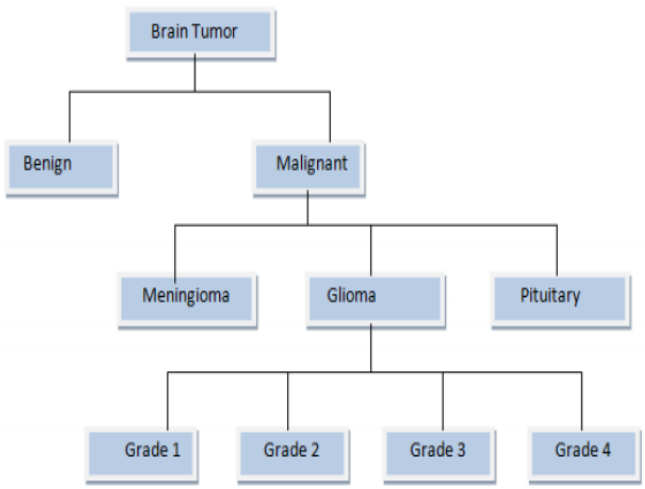

Fig. 1. Types of Brain Tumor

II. LITERATURE REVIEW

The utilization of DL and ML methods to detect and grade brain tumors using a variety of imaging techniques, especially MRI, is now widespread. This part presents the most current and associated research works which have written in various papers.

In [16], Two approaches for classifying brain tumors have been suggested by the authors. They used CNN in their first approach, which had four convolution layers, four pooling layers, one completely connected layer, and some intermediate layers for normalizing data. The accuracy of this approach in classifying brain tumors is 81.09 per cent. They used CNN to extract features and KELM to identify them in the second method. On this dataset, the accuracy of the KE-CNN process is 93.68 per cent, indicating that it is more reliable than the previous one. On the Based-on Literature Review, we also come up with a comparison table in which the techniques, used to perform the classification methodology are discussed.

In [17], The researchers took five pre-trained models to identify brain tumors: ResNet50, Xception, InceptionV3, VGG16, and MobileNet. Glioma tumor, meningioma tumor, no tumor, and pituitary tumor were the four ranks in the model. In this paper, the author aims to improve the effectiveness of MRI machines in classifying and detecting brain tumors. They validated five pre-trained design with pictures after training and validating them. They were able to achieve accuracies of between (97.25 per cent and 98.75 per cent). With a 98.75 per cent accuracy score, the Xception model was the most accurate.

In [18], based on DNN, a fully automated brain tumor classification system has been proposed. Images of low-grade and high-grade glioblastoma were also used to construct the proposed networks. This article represents a new CNN structure. In this cascading architecture, the yield of a vital CNN is utilized as a supplemental origin of knowledge for the upcoming CNN. Image processing algorithms and techniques are extremely useful in this area of research and offer a second opinion to help radiologists enhance their diagnosis and diagnostic accuracy.

In [19], For brain tumor segmentation, the author presented a CNN based classifier technique. The algorithm has two stages that are connected. In the primary phase, they trained CNN to learn the mapping from image space to tumor label space. They sent the predicted label response from CNN, along with the testing image, to an SVM classifier for accurate segmentation during the testing process. The deep CNN-SVM classifier is again repeated. Experiments and comparisons showed that the proposed system performs admirably either CNN-based or SVM-based segmentation independently. As compared to other techniques, the proposed method performs admirably. It also outperformed CNN or SVM alone in terms of tumor classification by a significant margin.

In [20], Fuzzy C Means (FCM) based segmentation is carried out Standard brain tumor classification. The level of difficulty is poor. However, the computation time is long, and the precision is poor. To increase accuracy and reduce computation time, the proposed scheme utilizes a classification method based on a convolution neural network. The outcomes of the classification are also classified as either tumor or non-tumor brain images. For classification purpose, an image net database is used. This model has proactively been prepared. Subsequently, just the last layer is prepared. CNN likewise determines crude pixel values with width, level and profundity, highlight values. At last, to accomplish high accuracy, the Gradient plunge based misfortune work is utilized. The accuracy of training's rate is 97.5 per cent. Validation precision is also high, with low validation loss.

In [21], When all of the GLCM features are combined with Contrast, accuracy can be enhanced. As a result, contrast is critical in assessing when brain tumors are identified. Two combined features with Contrast would be more accurate than two combined features without Contrast. Although the accuracy results including the Contrast work in the order interaction on a blend of mind growth information are immaterial, Contrast will further develop exactness by 20% on all mixes of highlights including Contrast.

In [22], For classifying three different types of brain tumors, the authors suggested a new CNN architecture. The created network was viewed as rudimentary than prior pre-prepared networks on T1-weighted contrast-improved attractive reverberation pictures. The organization's accomplishment was estimated utilizing four methodologies: two information bases and a mix of two 10-overlay cross-approval strategies. Subject-wise cross-approval, one of the 10-overlap draws near, was utilized to decide the organization's speculation capacity, and the improvement was tried utilizing an expanded picture information base. The record wise cross endorsement for the expanded enlightening file yielded the best result for the 10-overlay cross endorsement process, with an exactness of 96.56%.

In [23], Using a Deep Neural Network classifier, the researchers divided 66 brain MRIs into four main categories: metastatic bronchogenic carcinoma, normal, glioblastoma, sarcoma tumors.

In [24], The authors of this paper suggest a new method for categorizing brain medical images into normal and abnormal groups based on ConvNet. Brain tumor images are often divided into two categories: low and high. As a conceptual tumor classification technique, they used an altered version of the profound learning design on attractive reverberation pictures. Since the preparation set names are at the picture level on the other hand than the pixel level, the order is performed on the whole picture. The outcomes showed incredible progress in describing cerebrum pictures, with a precision of 91.16 percent.

In [25], the research is intended to help doctors detect brain tumor utilizing MRI pictures. In this analysis, images from The Cancer Imaging Repository (TCIA) were used. On images with a tumor, the suggested method has a recognition rate of 94.28 per cent, and on images without a tumor, it has a recognition rate of 100 per cent. Their system has a 96 per cent overall success rate, which is a better result than the comparison.

Table 1 : Comparative Analysis of various methods for detection and classification of brain tumor

Ref.	Data Set Use	Techniques	Accuracy/Result	Limitation
[18]	2013BRATS	Two-pathway CNN architecture and Cascaded architectures	A novel two-path way architecture is used to achieve high performance.	Create a separate pre diction for each segmentation label.
[19]	MRIimagesof30patients	For brain tumor segmentation, a CNN-based classifier model was adopted	Independently greater than CNN-based segmentation.	As the window sizes for SVM is increased the precision of the samples will decrease
[20]	BRATS2015	CNN Based Classification Method	97.5%	Training is performed for the only final layer.
[21]	Mg-pt,Mg-Gl, Gl-Pt, and Mg-Gl-Pt	CNN with GLCM	82%	The contrast feature is significant for gene rating higher accuracy
[17]	From Kaggle web site	Five pre-trained	98.75%, 98.50%, 98.00%, 97.50%, and 97.25%respectively	Pre-trained models are required
[22]	NHG Hospital, China	CNN architecture	96.56%.	Dedicated hardware for mealtime performance.
[23]	Harvard Medical School website	DWT with DNN	When compared to conventional classifiers, high accuracy.	High accuracy possible with DWT
[24]	(TCIA)	CNN	91.16%.	Only axial FLAIR-weighted MR images have been used in this study.
[25]	TCIA	Threshold method	96%	In accurately classified tumor images and the proposed method is not automatic procedure.
[16]	T1-weightedcontrast-enhancedMR	KE-CNN	93.68%	Data set limitations

III. CONCLUSIONS

This paper presents a comparative analysis of MRI-based brain tumor classification techniques. The intention of this paper is to define the various methods for classifying brain tumors using Deep Learning This comparative study reveals that each technique has advantages and disadvantages and that they all yield important results in terms of performance measurements. In this paper discussed the various techniques of brain tumor detection and classification. From this review it is inferred that Deep learning offers the influential structure for a brain tumor and which will provide considerable results.

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