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ABSTRACT

One of the most prevalent methods employed in medical research involves identifying brain tumors and monitoring their growth through brain MRI scans. By examining the internal structure of the human brain, valuable insights regarding tumor development can be obtained. However, manually detecting brain tumors from MRI scans poses a significant challenge within the medical research field, as tumors can lead to substantial alterations in both the internal and external brain structure. To address this issue, it is suggested to explore recent classifier approaches for the detection of brain tumors in MRI images. By utilizing these advanced techniques, the performance and analysis of brain tumor growth can be described, enabling the identification of general symptoms and facilitating a targeted diagnosis for an effective treatment plan. This discussion encompasses various classification approaches derived from existing research papers, ultimately leading to conclusive findings on brain tumor detection from MRI scans.

1. Introduction

Abnormal cell growths in the brain or surrounding tissues are known as brain tumors. Brain tumors can be classified as malignant (cancerous) or benign (non-cancerous), with the latter being more aggressive and perhaps fatal[1,2]. The classification system established by the World Health Organization (WHO) categorizes brain tumors into several primary groups. Gliomas are one of the most common forms; they are derived from glial cells. Gliomas can be further subdivided into ependymomas, oligodendrogliomas, and astrocytomas based on the particular glial cell that is implicated and the tumor's histological features. Another category of brain tumors is meningiomas, which develop from the meninges, the protective membranes enveloping the brain and spinal cord. Meningiomas are typically benign tumors characterized by a slow growth rate. Furthermore, pituitary tumors are identified by the

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WHO classification scheme. These tumors originate in the pituitary gland, which is located near the base of the brain. The pituitary gland is responsible for regulating hormone production. Pituitary tumors can disrupt hormonal balance and manifest in various symptoms[3].

Brain imaging techniques refer to the various methods used to visualize the brain's structure, function, and connectivity. These techniques allow researchers and clinicians to study the brain and diagnose neurological conditions. Magnetic resonance imaging (MRI), computed tomography (CT), electroencephalography (EEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI) are a few frequently utilized brain imaging modalities[4]. Among these techniques, MRI is considered one of the most versatile and widely used methods due to its exceptional anatomical detail, non-invasiveness, ability to capture functional and physiological data, and superior soft tissue contrast[5].

In order to interpret radiological and pathological pictures, sophisticated software systems called computer-aided detection and diagnosis (CAD) combine computer vision and artificial intelligence approaches. To help radiologists correctly diagnose a range of disorders in distinct anatomical locations, these cutting-edge technologies have been developed[6].

Machine learning has significantly accelerated the advancement of CAD systems. In recent times, machine learning has been applied to classify objects of interest, such as lesions, by leveraging input features. Machine learning enables the discovery and learning of informative features that effectively capture patterns and regularities in data. Unlike traditional approaches, where human experts design features based on domain knowledge, machine learning offers the ability to automate feature extraction. However, it should be noted that the complexity of living organisms far exceeds the superficial linear relationships detectable by traditional machine learning methods[7]. This highlights the need for more sophisticated approaches to uncover the intricate biology underlying disease detection and diagnosis.

2. Material and method

The fundamental difference between a traditional classifier and a deep Convolutional Neural Network (CNN) lies in their approach to feature extraction and pattern recognition. Traditional classifiers rely on manually engineered features, which are typically designed by domain experts[10]. These handcrafted features are based on prior knowledge and understanding of the problem domain. However, deep CNNs are made to automatically identify and extract pertinent features from unprocessed input, especially from material that resembles a grid, like pictures. Convolutional, pooling, and fully connected layers are just a few of the layers that CNNs use to learn hierarchical feature representations. Deep CNNs are able to automatically extract non-trivial features from the data, including spatial correlations and minute details that would be difficult for conventional classifiers to identify. As a result, deep CNNs are particularly effective in image-related tasks and have demonstrated superior performance in various domains specially in medical domain.

This paper provides an overview of research articles published between 2018 and 2022 that delve into the realm of brain tumor classification This overview focuses on using transfer learning techniques in conjunction with Convolutional Neural Networks (CNNs). Through the use of a transfer learning methodology, the research reviewed in this paper improves CNN models' classification performance in brain tumor analysis by utilizing prior information gleaned from extensive datasets.The paper aims to present a scientific overview of the advancements made in this domain during the specified time frame. This section is formulated as follows.

Figure 1 illustrate the basic structure of CNN.

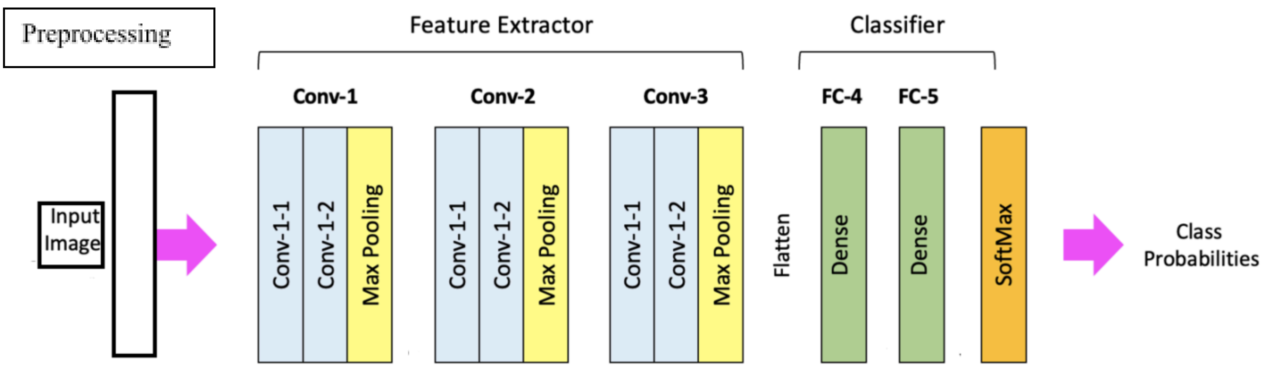

Fig. 1 Basic structure of CNN

Table 1 The comparison between transfer learning models.

Model	**Year**	**Number of Layers**	**Parameters (according to ImageNet)**	**Notable Feature**
VGG16	2014	16	138 million	Deep architecture, uniform structure
VGG19	2014	19	144 million	Deeper version of VGG16
MobileNet	2017	28	4.2 million	Depth wise separable convolutions
Residual connections	ResNet	2015	Varies (up to 152)	Varies
Inception	2014	Varies (up to 4)	Varies	Multiple parallel

3. Conclusion:

Transfer learning models are a promising approach for brain tumor detection in medical imaging. Compared to traditional machine learning algorithms and CNNs, transfer learning models offer several advantages, such as improved accuracy, reduced training time, and the ability to generalize well to new datasets.

Recent studies have demonstrated the effectiveness of transfer learning models in detecting brain tumors in MRI scans, achieving high accuracy levels even with small datasets. By leveraging pre-trained models that have already learned features from large datasets, transfer learning models can effectively extract meaningful features from MRI scans and enable accurate tumor detection.

While CNNs and traditional machine learning algorithms have also shown promise in detecting brain tumors, transfer learning models offer a more efficient and effective approach for this task. Moreover, transfer learning models can be easily adapted to different types of imaging modalities and can be fine-tuned on new datasets to achieve even higher accuracy levels.

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