Chapter 19
Multipath Convolutional Neural Network for Brain Tumor Detection (CNN)

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ABSTRACT

Brain tumor segmentation is a new automated medical image diagnosis application. A robust strategy to brain tumor segmentation and detection is an ongoing research problem, and the performance metrics of present tumor detection systems are little understood. Deep neural networks employing convolution neural networks (CNN) are being investigated in this regard; however, no generic architecture that can be employed as a robust technique for brain tumor diagnosis has been discovered. The authors have suggested a multipath CNN architecture for brain tumor segmentation and identification that outperforms existing approaches. The proposed work has been tested for datasets BRATS2013, BRTAS2015, and BRATS2017 with significant improvement in dice index and timing values by utilizing the capability of multipath CNN architecture, which combines both local and global paths. It was the objective to provide a simple and reliable method to determine segmentation and detection of brain tumor using brain tumor interface techniques (BCI).

DOI: 10.4018/978-1-7998-8892-5.ch019

INTRODUCTION AND BACKGROUND RESEARCH

Medical image processing covers wide research scope in the field of computer-aided diagnosis (CAD) for diagnosing various diseases. The analysis of the diagnosis deals with several medical imaging modalities such as MRI, X-ray, radiographic image, CT, mammograms etc. (Sinha, 2014). Image segmentation plays a very important role in the diagnosis and detection of abnormalities in medical images like tumors. There are numerous segmentation methods which are classified on the basis of pixel, region and threshold, referred as pixel-based method, region based and object-based methods. Segmentation plays very important role in CAD based tumor detection and used just before post-processing. The post-processing determines cancer stage or size and dimension of tumor (Sinha, 2014). Therefore, appropriate soft computing method is necessary to produce most efficient segmentation results. Currently, deep learning methods are used in such applications of medical imaging (Sinha, 2018). Assessment of human brain and its ability is also investigated with the help of medical imaging data and deep learning (Sinha, 2018) and so as the tumor detection. The cognitive brain tumor computing is associated with the model using cognition concept for training data. The mixing of training data of different types of tumor images is applied to the model that ensures effective training. The feature space and training model improve the performance (M. K. Chandrakar, 2022)

The human brain is the most interesting and complicated structure in the human body, which is made up of hundreds of billions of neurons and has stimulated a great deal of organ research. The regulation of muscles and the integration of body behavior, sensory perceptions, memory, cognition, speech, feeling, intelligence and consciousness are some of the central functions of the human brain (Cornish, 2017). The forebrain, midbrain, and hindbrain are three major components of the brain. There are four major brain regions: left and right brain, diencephalon, brain stem (midbrain, pons, and medulla oblongata) and cerebellum. All the methods that has been researched upon have been extensively studied and found that deep learning has tremendous scope of obtaining improved segmentation results that could help getting better diagnosis results for different medical images(M.K. Chandrakar, 2018)

The authors provided a classification model of mental tasks using electroencephalogram (EEG) on the concept of transfer learning, resolving data scarcity difficulties. CNN and SVM were used to validate the work. The accuracy of the results was the greatest, at 86.45 percent, using a typical benchmark of many other people's works for the same dataset as mentioned in(D. Singh and S. Singh, 2020.) there are many machine learning classification algorithms are available in machine learning like SVM, bagging, random forest in(S. S. Kshatri, 2021).

Suppose we live in rural areas far from health facilities or do not have enough money to pay our medical bills, or do not have time to leave our jobs sickly. In such a case it can be extremely useful to detect diseases using advanced devices. Many algorithms of AI were put forward and created to identify and diagnose diseases such as cancer, lung diseases, RA, DIR, Alzheimer's, hepatitis, Dengue fever, Liver and Parkenson's disease by computer scientists.(Bhardwaj, 2017).Deep learning involves using large neural networks of interconnected neurons and the ability to alter their hyperparameters as new data are obtained. (LeCun, 2015).as show in fig. 1

In adults, tumors develop in the cerebral cortex. In memory, thought, and other rational roles, the brain has a part to play. Tumors often develop in infants in the brain stem and cerebellum. The brain stem is near the cerebellum and regulates movement and coordination. Cancers, strokes and infections can affect the brain (Tarver, 2012). In July 2012, cancer and stroke were listed as the third and fourth