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Survey on Brain Tumor Detection using CNN Algorithm

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ABSTRACT: Nowadays brain tumor is a serious threat to the society because it can be fatal if not treated on time so it becomes very necessary to detect brain tumor in the initial stages which minimizes the risk of one's health. It can damage the brain as the mass of irregular cells inside the brain results in brain tumor which can be life-threatening. Brain tumor can be denoted as an abnormally formed mass of tissue where the cells multiply abruptly and continuously, that the growth of cells can't be controlled. The process of Image segmentation is adopted for extracting abnormal tumor region within the brain. In the MRI (magnetic resonance image), segmentation of brain tissue holds very significant in order to identify the presence of outlines concerning the brain tumor. There is abundance of hidden information in stored in the health care sector. With appropriate use of accurate data mining classification techniques, early prediction of any disease can be effectively performed. This survey paper presents a brief summary on brain tumor detection using machine learning algorithm used to increase efficiency and effectiveness of predicting brain tumor by comparing different algorithms such as CNN, Segmentation algorithm, KNN, FVM, SVM and GLCM. So, from this survey we come to the conclusion that CNN algorithm is better and can be used to diagnosis brain tumor by computer to make the diagnosis efficient a defective. The correct diagnosis and accurate classification of brain tumor detection is the main objective of this survey paper.

KEYWORDS: Brain Tumor, CNN, MRI.

I. INTRODUCTION

A brain tumour is an abnormal growth of tissue in the brain or central spine that can disrupt proper brain function and creates an increasing pressure in the brain. This paper is intended to present a comprehensive review of the methods of brain tumour detection through Magnetic Resonance Imaging (MRI) technique used in different stages of Computer Aided Detection System (CAD). It also provides a brief background on brain tumour in general and non-invasive imaging of brain tumour in order to give a comprehensive insight into the field. Lastly, the paper concludes with a concise discussion and provides a direction toward the upcoming trend of more advanced research studies on brain image segmentation and tumour detection. For successful treatment of the disease, accurate and early detection of brain tumours are essential. Early detection not only helps to come up with better medications, it can also save a life in due time. Machine learning algorithms are recently have been put to use for processing medical imagery and information in contrast to manual diagnosis of a tumour, which is a tiresome task and involves human error. Computer-aided mechanisms are applied to obtain better results as compared with manual traditional diagnosis practices. This is generally done by extracting features through a convolutional neural network (CNN) and then classifying using a fully connected network.



II. RELATED WORK

Author Name	Paper Name	Advantages	Disadvantage
Gunasekaran Manogaran, P.Mohamed Shakeel, Azza S. Hassanein, M.K.Priyan, C.Gokulnath	In Machine-Learning Approach Based Gamma Distribution for Brian Abnormalities Detection and Data Sample Imbalance Analysis	1. This paper is based on segmentation Algorithm 2. In this research, an improved orthogonal gamma distribution-based machine-learning approach is used to analyses the under segment and over segments of the brain tumor regions to detect the abnormality with automatic ROI detection	1. As processes are loaded and removed from the memory, the free memory space is broken into little pieces, causing External fragmentation. 2. The main drawback of segmentation algorithms is lack of context. To segment an object out of the complex environment, it is important to understand the context in which the objects find themselves.
Sergio Pereira, Adriano Pinto, Victor Alves and Carlos A. Silva	Brain Tumor Segmentation using Convolutiona Neural Networks in MRI Images	1.In this paper, a CNN architecture is proposed to classify different types and grades of brain tumors. The architecture of the network is evolved using different configuration to acquire the most appropriate structure. The paper is organized as follows; in section. 2. the proposed methodology is discussed in details starting from the original dataset and how manipulation occurs to adapt the CNN model to the tools and hardware resources used in this research	CNN do not encode the position and orientation of object. Lack of ability to be spatially invariant to the input data. Lots of training data is required
Komal Sharma, Akwinder Kaur, Shruti Gujral	Brain Tumor Detection based on Machine Learning Algorithms	In this paper, The advantage of the co-occurrence matrix calculations is that the co-occurring pairs of pixels can be spatially related in various orientations with reference to distance and angular spatial relationships, as on considering the relationship between two pixels at a time.	GLCM is a second-order statistical texture analysis method. It examines the spatial relationship among pixels and defines how frequently a combination of pixels are present in an image in a given direction Θ and distanced.

1. Gunasekaran Manogaran¹[1]In Machine-Learning Approach Based Gamma Distribution for Brian Abnormalities Detection and Data Sample Imbalance Analysis

Focused on the recent past artificial intelligence applications in Magnetic Resonance Imaging (MRI) is applied in various clinical researches. However, for analysing brain tumor without human intervention is considered as a significant area of research because the extracted brain images need to be optimized using segmentation algorithm which should have high resilient towards noise and cluster size sensitivity problem with automatic region of Interest (ROI) detection. In this research, an improved orthogonal gamma distribution-based machine-learning approach is used

to analyses the under segment and over segments of the brain tumor regions to detect the abnormality with automatic ROI detection. Further data imbalance due to improper edge matching in the abnormality region has been sampled by matching the edge coordinates and the sensitivity, selectivity parameters are measured using machine learning algorithm. The benchmark medical image database has been collected and experimentally analyse to validate the efficiency, accuracy, optimal automatic detection for tumor and non-tumor region and mean error rate of the algorithm using mathematical formulation. This research pays its proficiency in the field of brain abnormality detection and analysis in health care sector without an human intermediation.

2. **Sergio Pereira [2] Brain Tumor Segmentation using Convolutional Neural Networks in MRI Images**
Image segmentation is used in medical field for the identification of brain tumor. MRI is helps to detect brain tumor. The introduced segment method resolves the multi model brain analysis challenges (MICCAI BraTS 2013). The structures isolated here are intensity differences, local neighborhood and texture. The isolated structure is analyzed and classified by applying random forest approach that helps to predict different classes by utilizing various regions. The aim of this research is for accurate classification of tumor cells from the normal cells compare to other methods.

3. **Komal Sharma [3]Brain Tumor Detection based on Machine Learning Algorithms**

In this paper, an efficient automated classification technique for brain MRI is proposed using machine learning algorithms. The supervised machine learning algorithm is used for classification of brain MRI image.

- **Limitations of Segmentation:**

1. As processes are loaded and removed from the memory, the free memory space is broken into little pieces, causing External fragmentation.
2. The main drawback of segmentation algorithms is lack of context. To segment an object out of the complex environment, it is important to understand the context in which the objects find themselves.

- **Limitations of GLCM:**

1. GLCM is a second-order statistical texture analysis method. It examines the spatial relationship among pixels and defines how frequently a combination of pixels are present in an image in a given direction Θ and distanced. And therefore, it requires a highly trained professional programmer to understand the matrix. They require a lot of computation (many matrices to be computed). Features are not invariant to rotation or scale changes in the texture.

- **Limitations of KNN:**

KNN is a very powerful algorithm. It is also called “lazy learner”. However, it has the following set of limitations:

1. **Doesn't work well with a large dataset:**

Since KNN is a distance-based algorithm, the cost of calculating distance between a new point and each existing point is very high which in turn degrades the performance of the algorithm.

2. **Doesn't work well with a high number of dimensions:**

Again, the same reason as above. In higher dimensional space, the cost to calculate distance becomes expensive and hence impacts the performance.

3. **Sensitive to outliers and missing values:**

KNN is sensitive to outliers and missing values and hence we first need to impute the missing values and get rid of the outliers before applying the KNN algorithm.

- **Limitations of Naïve Bayes:**

1. Main imitation of Naive Bayes is the assumption of independent predictors. Naive Bayes implicitly assumes that all the attributes are mutually independent. In real life, it is almost impossible that we get a set of predictors which are completely independent.
2. If categorical variable has a category in test data set, which was not observed in training data set, then model will assign a 0 (zero) probability and will be unable to make a prediction. This is often known as Zero Frequency.
3. Its estimations can be wrong in some cases, so you shouldn't take its probability outputs very seriously.

- **FCM Algorithm:**

Clustering is a process of grouping data into clusters such that objects of the same cluster share some similarity. Many clustering algorithms have been introduced. Among these, the fuzzy c-means (FCM) clustering algorithm is the most widely used in a variety of engineering and scientific areas such as image and pattern analysis, medicine, decision-making, and machine learning. The FCM algorithm is introduced by Dunn and later, it is generalized by with and became very popular. However, the FCM algorithm has several disadvantages. For example, it performs poorly on data sets that contain clusters with unequal sizes or densities, and it is sensitive to noise and outliers. To overcome these FCM drawbacks, many variants of FCM algorithms have been proposed. There are two fundamental approaches to address the robustness of fuzzy clustering methods.

- **Expectation-Maximization algorithm:**

An be used for the latent variables (variables that are not directly observable and are actually inferred from the values of the other observed variables) too in order to predict their values with the condition that the general form of probability distribution governing those latent variables is known to us. This algorithm is actually at the base of many unsupervised clustering algorithms in the field of machine learning. It was explained, proposed and given its name in a paper published in 1977 by Arthur Dempster, Nan Laird, and Donald Rubin. It is used to find the *local maximum likelihood parameters* of a statistical model in the cases where latent variables are involved and the data is missing or incomplete.

Disadvantages of EM algorithm –

1. It has slow convergence.
2. It makes convergence to the local optima only.
3. It requires both the probabilities, forward and backward (numerical optimization requires only forward probability).

- **Problems with Faster RCNN:**

All of the object detection algorithms we have discussed so far use regions to identify the objects. The network does not look at the complete image in one go, but focuses on parts of the image sequentially. This creates two complications: The algorithm requires many passes through a single image to extract all the objects as there are different systems working one after the other, the performance of the systems further ahead depends on how the previous systems performed.

- **Advantages of CNN:**

In this paper, a CNN architecture is proposed to classify different types and grades of brain tumors. The architecture of the network is evolved using different configuration to acquire the most appropriate structure. The paper is organized as follows; in section 2, the proposed methodology is discussed in details starting from the original dataset and how manipulation occurs to adapt the CNN model to the tools and hardware resources used in this research. Section 3 and, 4 are dedicated to results and discussion respectively followed by a conclusion.

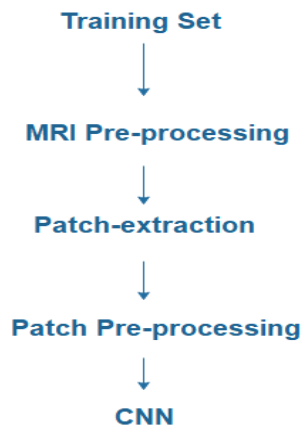
Natarajan et al. proposed brain tumor detection method for MRI brain images. The MRI brain images are first pre-processed using median filter, then segmentation of image is done using threshold segmentation and morphological operations are applied and then finally, the tumor region is obtained using image subtraction technique. This approach gives the exact shape of tumor in MRI brain image. Joshi et al. proposed brain tumor detection and classification system in MR images by first extracting the tumor portion from brain image, then extracting the texture features of the detected tumor using Gray Level Co-occurrence Matrix (GLCM) and then classified using neuro-fuzzy classifier. Amin and Mageed proposed neural network and segmentation base system to automatically detect the tumor in brain MRI images. The Principal Component Analysis (PCA) is used for feature extraction and then Multi-Layer Perceptron (MLP) is used classify the extracted features of MRI brain image. The average recognition rate is 88.2% and peak recognition rate is 96.7%. Sapra et al. proposed image segmentation technique to detect brain tumor from MRI images and then Probabilistic Neural Network (PNN) is used for automated brain tumor classification in MRI scans. PNN system proposed handle the process of brain tumor classification more accurately. Suchita and Lalit proposed unsupervised neural network learning technique for classification of brain MRI images. The MRI brain images are first preprocessed which include noise filtering, edge detection, then the tumor is extracted using segmentation. The texture features are extracted using Gray-Level Co-occurrence Matrix (GLCM) and then Self-Organizing Maps (SOM) are used to classify the brain as normal or abnormal brain, that is, whether it contain tumor or not. Rajeshwari and Sharmila [6] proposed



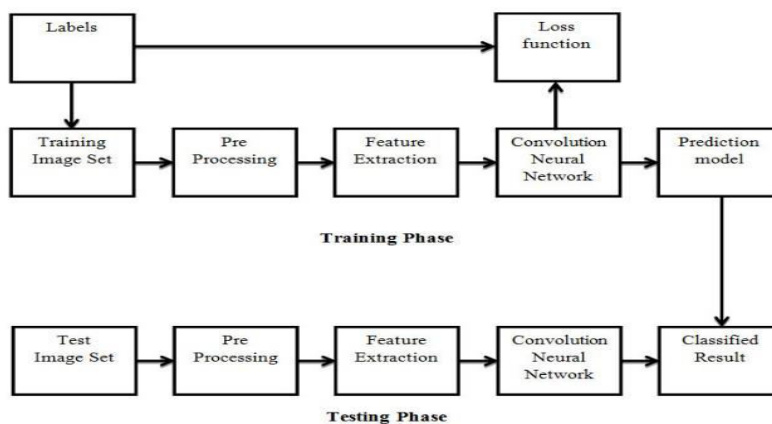
pre-processing techniques which are used to improve the quality of MRI image before using it into an application. The average, median and wiener filters are used for noise removal and interpolation based Discrete Wavelet Transform (DWT) technique is used for resolution enhancement. The Peak Signal to Noise Ratio (PSNR) is used for evaluation of these techniques.

III. METHODOLOGY

In this figure in the initial stage, data sets of MRI images will be pre-processed then the pre-processed images will move towards the patch extraction phase in which the mean of each patch is removed from each pixel's value.



Patches are sorted based on their energy, those with a high level of energy are kept by thresholding. After that the next step is patch pre-processing in which the patch will be pre-processed and the steps will be taken to format patches before they are used by model training and inference. After patch pre-processing Convolutional Neural Network is a Machine Learning algorithm will be used, which can take in an input image, assign importance (learnable weights and biases) to various aspects in the image and be able to differentiate one from the other.



Architecture Diagram

This topic will play an important role in the research and the medical advancement that is happening out there in the world; the analysis of the results signifies that the integration of multidimensional data along with different classification, feature selection and dimensionality reduction techniques can provide auspicious tools for inference in this domain. Further research in this field should be carried out for the better performance of the classification techniques so that it can predict on more variables. We are intending how to parameterize our classification techniques hence to achieve high accuracy. We are looking into many datasets and how further Machine Learning algorithms can be used to characterize Brain Tumour.

IV. CONCLUSION

The Brain tumour detection decision support system assists and helps doctors in making the best, most accurate, and quickest decisions possible while also reducing total treatment costs. By predicting strokes at an early stage, the suggested technique lowers treatment costs and improves quality of life. We were able to attain a stunning 97 percent accuracy on a specific dataset by using Artificial Neural Networks, which is a tremendous outcome in terms of science and creativity and will help you have fewer people die from malignancies and offer required aid at an early stage.

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