Enhanced Prediction of Brain Tumor Growth through Advanced Machine Learning Techniques

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Abstract— *Brain tumors pose significant health risks, requiring effective treatment planning for patient survival. Medical imaging techniques like MRI assist in tumor diagnosis, but manual classification is hindered by data volume. Automatic classification schemes, such as CNN, are crucial for accurate detection and treatment.*

I. INTRODUCTION

The brain consists of billions of cells, some of which can form tumors. These tumors are categorized as low grade (benign) or high grade (malignant). MRI imaging is crucial for tumor detection and treatment planning due to its detailed information about brain structure. Machine learning techniques like Neural Networks and Support Vector Machines have been commonly used for tumor detection, but recently, Deep Learning models have gained traction due to their ability to represent complex relationships effectively

II. LITERATURE REVIEW

2.1 Tumor Detection in the Brain using Faster R-CNN

Brain tumor is the cancerous disease where abnormal cells found in the brain. This can be cured if we detect the brain tumor at an early stage. In this proposed system the tumor area is marked and defined what kind of tumor present in the brain tumor MRI image. AlexNet model is used for the classification of different types of tumors as a base model along with Region Proposal Network (RPN) by Faster R-CNN algorithm. Here, the concept of transfer learning is used during training. The proposed system helps to predict the correct type of tumor with better accuracy.

2.2 Brain Tumor Classification Using Convolutional Neural Networks

Seetha, J, S. Selvakumar Raja

Brain tumors are a major health concern, requiring accurate diagnosis for effective treatment planning. MRI imaging is commonly used for brain tumor diagnosis, but manual classification is hindered by the large amount of data generated. To address this challenge, automatic classification schemes, such as Convolutional Neural Networks (CNN), are proposed. In this study, a CNN with a deep architecture design using small kernels achieves high accuracy (97.5%) with low complexity, outperforming other state-of-the-art methods.

2.3 Brain Tumor Detection Based On Convolutional Neural Network With Neutrosophic Expert Maximum Fuzzy Sure Entropy

Fatih Özyurt, Eser Sert, Engin Avci, Esin Dogantekin

Brain tumor classification is a challenging task in the field of medical image processing. The present study proposes a hybrid method using Neutrosophy and Convolutional Neural Network (NS-CNN). It aims to classify tumor region areas that are segmented from brain images as benign and malignant. In the first stage, MRI images were segmented using the neutrosophic set – expert maximum fuzzy-sure entropy (NS-EMFSE) approach. The features of the segmented brain images in the classification stage were obtained by CNN and classified using SVM and KNN classifiers. Experimental evaluation was carried out based on 5-fold cross-validation on 80 of benign tumors and 80 of malign tumors. The findings demonstrated that the CNN features displayed a high classification performance with different classifiers. Experimental results indicate that CNN features displayed a better classification performance with SVM as simulation results validated output data with an average success of 95.62%.

2.4 Brain Tumor Detection and Segmentation in MR Images Using Deep Learning

Gliomas are aggressive brain tumors, posing challenges for accurate segmentation due to their irregular shape and diffuse boundaries. This study introduces a deep learning-based method for glioma segmentation using MRI data. The proposed hybrid convolutional neural network leverages patch-based approach and addresses over-fitting with dropout regularization and batch normalization. Data imbalance is tackled using a two-phase training procedure. Pre-processing includes image normalization and bias field correction, while post-processing removes small false positives. Validation on BRATS 2013 dataset shows improved results compared to state-of-the-art techniques.

2.5 Brain Tumor Detection Using Fusion Of Hand Crafted And Deep Learning Features

The proposed method enhances brain tumor diagnosis by combining GrabCut for lesion segmentation and fine-tuned VGG-19 for feature extraction. These features, along with hand-crafted features, are optimized for accurate classification. Tested on MICCAI challenge databases, achieving high DSC scores: 0.99 on BRATS 2015, 1.00 on BRATS 2016, and 0.99 on BRATS 2017.

Problem Statement

- Primary brain tumors begin when normal cells acquire errors (mutations) in their DNA. These mutations allow cells to grow and divide at increased rates and to continue living when healthy cells would die. The result is a mass of abnormal cells, which forms a tumor.
- Only early prediction could help to better diagnose the tumor problems at the benign stage to save a person’s life.

Disadvantages

- The existing system used different algorithm to predict the disease, but accuracy is low comparison of our model.
- Complexity is high.
- Training and Testing the model is used same algorithm, but we provide different method.

III. PROPOSED WORK

- It involves Dense Layer in Convolutional Neural Network (CNN) Algorithm in Deep Learning concept used to train the dataset.
- In **Dense Layer**, each layer obtains additional inputs from all preceding layers and passes on its own feature-maps to all subsequent layers.
- In Dense Layer uses features of all complexity levels. It tends to give more smooth decision boundaries.

Advantages

- Easy detection of the Brain Tumor with the concluded technique.
- Time consuming.
- Best accuracy Model helps in better treatment as early.
- Detection of best Model will quick the treatment which is life saving

3.1 Dataset Collection and Pre-processing

A dataset (or data set) is a collection of data, usually presented in tabular form. Each column represents a particular variable. Each row corresponds to a given member of the dataset in question. It lists values for each of the variables, such as height and weight of an object. Each value is known as a datum.

We have chosen to use a publicly-available Healthcare dataset which contains a relatively small number of inputs and cases. The data is arranged in such a way that will allow those trained in medical disciplines to easily draw parallels between familiar statistical and novel ML techniques. Additionally, the compact dataset enables short computational times on almost all modern computers.

3.2 Standardization, or Mean removal and Variance Scaling

Standardization of datasets is a **common requirement for many machine learning estimators** implemented in scikit-learn; they might behave badly if the individual features do not more or less look like standard normally distributed data: Gaussian with **zero mean and unit variance.**

3.3 Segmentation

Image segmentation divides an image into meaningful regions for analysis. Various algorithms assign labels to pixels, grouping them based on similarities. This allows for boundary specification and object separation. Different methods yield varying levels of complexity and outputs.

3.4 Classification

Image classification is to identify and portray, as a unique gray level (or color), the features occurring in an image in terms of the object or type of land cover these features actually represent on the ground. Image classification is perhaps the most important part of digital image analysis.

3.4.1 K-Nearest Neighbours

Neighbours based classification is a type of lazy learning as it does not attempt to construct a general internal model, but simply stores instances of the training data. Classification is computed from a simple majority vote of the k nearest neighbours of each point.

3.4.2 Support Vector Machine

is a representation of the training data as points in space separated into categories by a clear gap that is as wide as possible? New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall.

IV. CONCLUSION AND FUTURE WORK

The research aims to create an accurate and efficient brain tumor classification system. Traditional methods like Fuzzy C Means with SVM and DNN show low accuracy and high computation time. To improve this, a convolutional neural network (CNN) approach is proposed, enhancing accuracy and reducing computation time. The CNN is implemented using Python, leveraging the ImageNet database for classification. Pre-trained models are utilized, with training focused on the final layer. Features extracted include raw pixel values and dimensions. Gradient descent-based loss function ensures high accuracy, with training and validation showing promising results.

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