Improved Brain Tumour Growth Prediction using ML Techniques

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***Abstract*—** *The brain tumours, are the most common and aggressive disease, leading to a very short life expectancy in their highest grade. Thus, treatment planning is a key stage to improve the quality of life of patients. Generally, various image techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and ultrasound image are used to evaluate the tumor in a brain, lung, liver, breast, prostate etc. Especially, in this work MRI images are used to diagnose tumor in the brain. However, the huge amount of data generated by MRI scan thwarts manual classification of tumor vs non-tumor in a particular time. But it having some limitation (i.e) accurate quantitative measurements is provided for limited number of images. Hence trusted and automatic classification scheme are essential to prevent the death rate of human. The automatic brain tumor classification is very challenging task in large spatial and structural variability of surrounding region of brain tumor. In this work, automatic brain tumor detection is proposed by using Convolutional Neural Networks (CNN) classification.*

I. INTRODUCTION

Brain tumor is one of the vital organs in the human body, which consists of billions of cells. The abnormal group of cells is formed from the uncontrolled division of cells, which is also called as tumor. Brain tumor are divided into two types such low grade (grade1 and grade2) and high grade (grade3 and grade4) tumor. Low grade brain tumor is called as benign. Similarly, the high grade tumor is also called as malignant. Benign tumor is not cancerous tumor. Hence it doesn't spread other parts of the brains. However, the malignant tumor is a cancerous tumor. So, it spreads rapidly with indefinite boundaries to other region of the body easily. It leads to immediate death.

Brain MRI image is mainly used to detect the tumor and tumor progress modeling process. This information is mainly used for tumor detection and treatment processes.MRI image gives more information about given medical image than the CT or ultrasound image. MRI image provides detailed information about brain structure and anomaly detection in brain tissue. Actually, Scholars offered unlike automated methods for brain tumours' finding and type cataloguing using brain MRI images from the time when it became possible to scan and freight medical images to the computer. Conversely, Neural Networks (NN) and Support Vector Machine (SVM) are the usually used methods for their good enactment over the most recent few years11. However freshly, Deep Learning (DL) models fixed a stirring trend in machine learning as the subterranean architecture can efficiently represent complex relationships without needing a large number of nodes like in the superficial architectures e.g., K-Nearest Neighbor (KNN) and Support Vector Machine (SVM).Consequently, they grew quickly to become the state of the art in unlike health informatics areas for example medical image analysis, medical informatics and bio-informatics.

II. LITERATURE REVIEW

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.

Brain Tumor Classification Using Convolutional Neural Networks

Seetha, J, S. Selvakumar Raja

The brain tumors, are the most common and aggressive disease, leading to a very short life expectancy in their highest grade. Thus, treatment planning is a key stage to improve the quality of life of patients. Generally, various image techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and ultrasound image are used to evaluate the tumor in a brain, lung, liver, breast, prostate…etc. Especially, in this work MRI images are used to diagnose tumor in the brain. However the huge amount of data generated by MRI scan thwarts manual classification of tumor vs non-tumor in a particular time. But it having some limitation (i.e) accurate quantitative measurements is provided for limited number of images. Hence trusted and automatic classification scheme are essential to prevent the death rate of human. The automatic brain tumor classification is very challenging task in large spatial and structural variability of surrounding region of brain tumor. In this work, automatic brain tumor detection is proposed by using Convolutional Neural Networks (CNN) classification. The deeper architecture design is performed by using small kernels. The weight of the neuron is given as small. Experimental results show that the CNN archives rate of 97.5% accuracy with low complexity and compared with the all-other state of arts methods.

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%.

Brain Tumor Detection and Segmentation in MR Images using Deep Learning

Gliomas are the most infiltrative and life-threatening brain tumors with exceptionally quick development. Gliomas segmentation using computer-aided diagnosis is a challenging task, due to irregular shape and diffused boundaries of tumor with the surrounding area. Magnetic resonance imaging (MRI) is the most widely used method for imaging structures of interest in human brain. In this study, a deep learning-based method that uses different modalities of MRI is presented for the segmentation of brain tumor. The proposed hybrid convolutional neural network architecture uses patch-based approach and takes both local and contextual information into account, while predicting output label. The proposed network deals with over-fitting problem by utilizing dropout regularize alongside batch normalization, whereas data imbalance problem is dealt with by using two-phase training procedure. The proposed method contains a pre-processing step, in which images are normalized and bias field corrected, a feed-forward pass through a CNN and a post-processing step, which is used to remove small false positives around the skull portion. The proposed method is validated on BRATS 2013 dataset, where it achieves scores of 0.86, 0.86 and 0.91 in terms of dice score, sensitivity and specificity for whole tumor region, improving results compared to the state-of-the-art techniques.

Brain Tumor Detection using Fusion of Hand Crafted and Deep Learning Features

The perilous disease in the worldwide now a days is brain tumor. Tumor affects the brain by damaging healthy tissues or intensifying intra cranial pressure. Hence, rapid growth in tumor cells may lead to death. Therefore, early brain tumor diagnosis is a more momentous task that can save patient from adverse effects. In the proposed work, the Grab cut method is applied for accurate segmentation of actual lesion symptoms while Transfer learning model visual geometry group (VGG-19)

is fine-tuned to acquire the features which are then concatenated with hand crafted (shape and texture) features through serial-based method. These features are optimized through entropy for accurate and fast classification and fused vector is supplied to classifiers. The presented model is tested on top medical image computing and computer-assisted intervention (MICCAI) challenge databases including multimodal brain tumor segmentation (BRATS) 2015, 2016, and 2017 respectively. The testing results with dice similarity coefficient (DSC) achieve 0.99 on BRATS 2015, 1.00 on BRATS 2015 and 0.99 on BRATS 2017 respectively.

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.

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**.**

3.2 Segmentation

Image segmentation is the process of dividing the image into non- overlapping meaningful regions. The main objective if an image segmentation is to divide an image into many sections for the further analysis, so we can get the only necessary or a segment of information. We use various image segmentation algorithms to split and group a certain set of pixels together from the image. By doing so, we are actually assigning labels to pixels and the pixels with the same label fall under a category where they have some or the other thing common in them.

Using these labels, we can specify boundaries, draw lines, and separate the most required objects in an image from the rest of the not-so-important ones. In the below example, from a main image on the left, we try to get the major components, e.g., chair, table etc. and hence all the chairs are coloured uniformly. In the next tab, we have detected instances, which talk about individual objects, and hence the all the chairs have different colours.

This is how different methods of segmentation of images work in varying degrees of complexity and yield different levels of outputs.

3.3 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.

3.3.1 K-Nearest Neighbors

Neighbors 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 neighbors of each point.

3.3.2 Support Vector Machine

It 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. IMPLEMENTATION

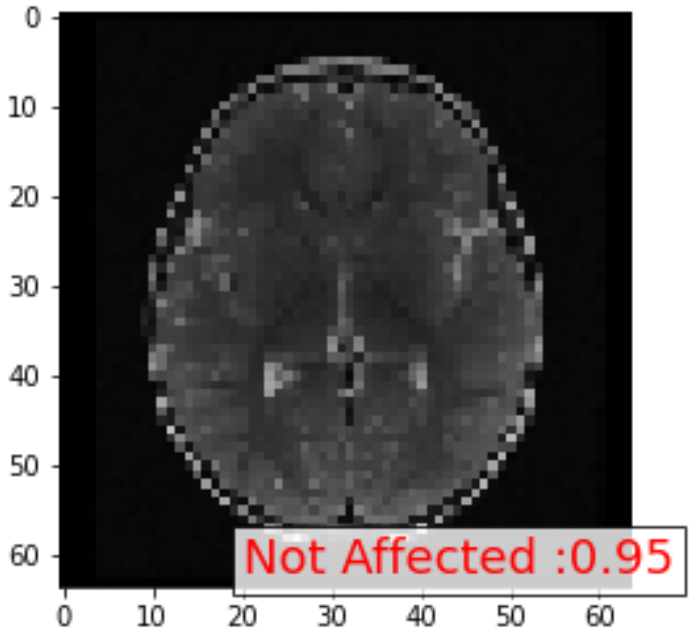

FIGURE 1: Image Prediction Using CNN

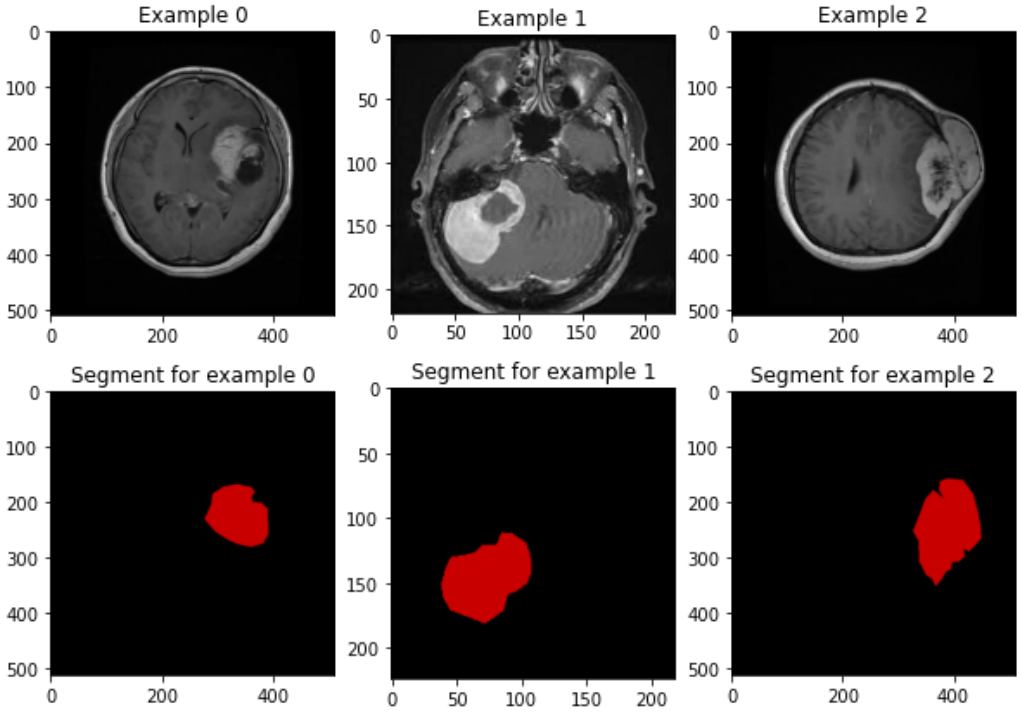

FIGURE 2: Segmentation of Brain Tumor Images

V. CONCLUSION AND FUTURE WORK

The main goal of this research work is to design efficient automatic brain tumor classification with high accuracy, performance and low complexity. In the conventional brain tumor classification is performed by using Fuzzy C Means (FCM) based segmentation, texture and shape feature extraction and SVM and DNN based classification are carried out. The complexity is low. But the computation time is high meanwhile accuracy is low. Further to improve the accuracy and to reduce the computation time, a convolution neural network-based classification is introduced in the proposed scheme. Also, the classification results are given as tumor or normal brain images. CNN is one of the deep learning methods, which contains sequence of feed forward layers. Also, python language is used for implementation. Image net database is used for classification. It is one of the pre-trained models. So, the training is performed for only final layer. Also, raw pixel value with depth, width and height feature value are extracted from CNN. Finally, the Gradient decent based loss function is applied to achieve high accuracy. The training accuracy, validation accuracy and validation loss are calculated. The training accuracy is 97.5%. Similarly, the validation accuracy is high and validation loss is very low.

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