International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457
IMPACT FACTOR : 4.101

ICNSCET20- International Conference on New Scientific Creations in Engineering and Technology

FMRI BRAIN IMAGE SEGMENTATION AND CLASSIFIATION USING BIG DATA ANALYTICS

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Abstract— Brain MRI segmentation is an essential task in many clinical applications because it influences the outcome of the entire analysis. This is because different processing steps rely on accurate segmentation of anatomical regions. Enormous progress in accessing brain injury and exploring brain anatomy has been made using magnetic resonance imaging (MRI). The advances in brain MR imaging have also provided large amount of data with an increasingly high level of quality. This manual analysis is often time-consuming and prone to errors due to various inter- or intra operator variability studies. These difficulties in brain MRI data analysis required inventions in computerized methods to improve disease diagnosis and testing. The images produced by MRI are high in tissue contrast and have fewer artifacts. It has several advantages over other imaging techniques, providing high contrast between soft tissues. However, the amount of data is far too much for manual analysis, which has been one of the biggest obstacles in the effective use of MRI. The detection of tumor requires several processes on MRI images which includes image pre-processing, feature extraction, image segmentation and classification. In this project, we can implement various image segmentation methods such as K-means clustering, Fuzzy K- means clustering and Adaptive fuzzy K means clustering with various distances measures that includes Euclidean distance. The final classification process such as deep learning approach concludes that a person is diseased or not. Although numerous efforts and promising results are obtained in medical imaging area, reproducible segmentation and classification of abnormalities and image intensities of diseases with improved accuracy rates and provide reduce number of error rates.

Keywords—**MRI; K-means clustering ; Fuzzy K- means clustering ; Adaptive fuzzy K means clustering; Improved accuracy rates and provide reduce number of error rates.**

I. INTRODUCTON

Big data analytics is the often complex process of examining large and varied data sets to uncover information including hidden patterns, unknown correlations, market trends and customer preferences that can help organizations make informed business decisions.

Big data analytics is a form of advanced analytics, which involves complex applications with elements such as predictive models, statistical algorithms and what-if analysis powered by high-performance analytics systems.

Big data analytics applications often include data from both internal systems and external sources, such as weather data or demographic data on consumers compiled by third-party information services providers

Semi-structured and unstructured data may not fit well in traditional data warehouses based on relational databases. Furthermore, data warehouses may not be able to handle the processing demands posed by sets of big data that need to be updated frequently or even continually -- for example, real-time data on the performance of mobile applications or of oil and gas pipelines. As a result, many organizations looking to collect, process and analyze big data have turned to a newer class of technologies that includes Hadoop and related tools such as YARN, MapReduce, Spark, Hive and Pig as well as NoSQL databases. Those technologies form the core of an open source software framework that supports the processing of large and diverse data sets across clustered systems.

In some cases, Hadoop clusters and NoSQL systems are being used as landing pads and staging areas for data before it gets loaded into a data warehouse for analysis, often in a summarized form that is more conducive to relational structures. Increasingly though, big data vendors are pushing the concept of a Hadoop data lake that serves as the central repository for an

II. LITERATURE SURVEY

1.DEEPLAB: SEMANTIC IMAGE SEGMENTATION WITH DEEP CONVOLUTIONAL NETS, ATROUS CONVOLUTION, AND FULLY CONNECTED CRFS

Liang-Chieh Chen, et.al,… proposed "DeepLab" system re-purposes networks trained on image classification to the task of semantic segmentation by applying the 'atrous convolution' with upsampled filters for dense feature extraction. We further extend it to atrous spatial pyramid pooling, which encodes objects as well as image context at multiple scales. To produce semantically accurate predictions and detailed segmentation maps along object boundaries, we also combine ideas from deep convolutional neural networks and fully-connected conditional random fields. Our experimental results show that the proposed method significantly advances the state-of art in several challenging datasets, including PASCAL VOC 2012 semantic image segmentation benchmark, PASCAL Context, PASCAL-Person-Part, and Cityscapes datasets. Compared to regular convolution with larger filters, atrous convolution allows us to effectively enlarge the field of view of filters without increasing the number of parameters or the amount of computation.

2. FAST FULLY AUTOMATIC SEGMENTATION OF THE HUMAN PLACENTA FROM MOTION CORRUPTED MRI

Amir Alansary, et.al,…presented a fully automatic segmentation framework for the human placenta from motion corrupted fetal MRI scans. We perform rigorous experiments on two different testing datasets in order to evaluate thoroughly the presented segmentation approach, which is based on a 3D deep multi-scale convolutional neural network combined with conditional random field segmentation refinement. The functions of the placenta affect the fetal birth weight, growth, prematurity, and neuro-development since it controls the transmission of nutrients from the maternal to the fetal circulatory system. Recent work [8] has shown that magnetic resonance imaging (MRI) can be used for the evaluation of the placenta during both normal and high-risk pregnancies. Particularly, quantitative measurements such as placental volume and surface attachment to the uterine wall, are required for identifying abnormalities. In addition, recording the structural appearance (e.g., placental cotyledons and shape) is essential for clinical qualitative analysis. Moreover, the placenta is usually examined after birth, on a flat surface providing a standard representation for obstetricians. Flat cutting planes, as common in radiology, show only a small part of the placenta. A 3D visualization is considered useful in particular for cases that require preoperative planning or surgical navigation (e.g. treatment of twin-to-twin transfusion syndrome).

3.AUTOMATED FETAL BRAIN SEGMENTATION FROM 2D MRI SLICES FOR MOTION CORRECTION

K. Keraudren, et.al,…proposed the application of a patch-based Random Forest classifier to obtain a probabilistic slice-by-slice segmentation of the brain, which is then refined with a 3D Conditional Random Field. The novelty of this approach is to perform online learning with a global classifier, where as a typical patch-based segmentation uses offline learning with a local classifier. Abnormal brain growth resulting in a smaller brain was simulated by altering the gestational ages in our dataset. As can be expected from the filtering by size taking place during the brain detection process, the method showed some sensitivity to abnormal sizes of the brain, with the mean Dice score of the RF/CRF segmentation decreasing by 3.8%. However, it can be expected that brains with a very abnormal structure, in conditions such as severe ventriculomegaly or hydrocephalus, will not be segmented with the proposed method without including subjects with similar pathologies in the training dataset. Indeed, for the trained classifier in the detection process to be able to generalize from the training data to any unseen subject, this training data needs to be representative of the possible test cases.

4.THE MULTIMODAL BRAIN TUMOR IMAGE SEGMENTATION BENCHMARK (BRATS)

BjoernH.Menze, et.al,… presented the BRATS brain tumor segmentation benchmark. We generated the largest public dataset available for this task and evaluated a large number of state-of-the-art brain tumor segmentation methods. Our results indicate that, while brain tumor segmentation is difficult even for human raters, currently available algorithms can reach Dice scoresofover80%forwholetumorsegmentation.Segmenting the tumor core region, and especially the active core region in high-grade gliomas, proved more challenging, with Dice scores reaching 70% and 60%, respectively. Of the algorithms tested, no single method performed best for all tumor regions considered. However, the errors of the best algorithms for each individual region fell with in human inter-rater variability. An important observation in this study is that fusing different segments boosts performance significantly. Decisions obtained by applying a hierarchical majority vote to fixed groups of algorithmic segmentations performed consistently, for every single segmentation task, better than the best individual segmentation algorithm. This suggests that, in addition to pushing the limits of individual tumor segmentation algorithms, future gains (and ultimately clinical implementations) may also be obtained by investigating how to implement and fuse several

5. SCALABLE MULTIMODAL CONVOLUTIONAL NETWORKS FOR BRAIN TUMOUR SEGMENTATION

Lucas Fidon, et.al,..propose a scalable network framework (ScaleNets) that enables efficient

refinement of an existing architecture to adapt it to an arbitrary number of MR modalities instead of building a new architecture from scratch. ScaleNets are CNNs split into a backend and frontend with a cross-modality information flowing through the backend thereby alleviating the need for a one-shot latent space merging. The proposed scalable backend takes advantage of a factorization of the feature space into imaging modalities (M-space) and modality-conditioned features (F-space). By explicitly using this factorization, we impose sparsity on the network structure with demonstrated improved generalization. Comparison of classic and scalable CNNs shows that scalable networks are more robust and use fewer parameters while maintaining similar or better accuracy for medical image segmentation. Scalable network structures have the potential to make deep network for medical images more reusable. We believe that scalable networks will play a key enabling role for efficient transfer learning in volumetric MRI analysis.

6. PARAMETRIC ESTIMATE OF INTENSITY INHOMOGENEITIES APPLIED TO MRI

Styner, Martin, et al.presented a new approach to the correction of intensity in homogeneities in magnetic resonance imaging (MRI) that significantly improves intensity-based tissue segmentation. The estimation of the parametric bias field is formulated as a nonlinear energy minimization problem using an evolution strategy (ES). The resulting bias field is independent of the image region configurations and thus overcomes limitations of methods based on homomorphism filtering. Furthermore, PABIC can correct bias distortions much larger than the image contrast. The polynomial approach combines bias correction with histogram adjustment, making it well suited for normalizing the intensity histogram of datasets from serial studies. A large number of MR image data acquired with breast, surface, and head coils, both in two dimensions and three dimensions, have been processed and demonstrate the versatility and robustness of this new bias correction scheme.

7.DETECTION OF PRODROMAL ALZHEIMER'S DISEASE VIA PATTERN CLASSIFICATION OF MAGNETIC RESONANCE IMAGING

Davatzikos, Christos, et al.reported to provide evidence that computer-based high-dimensional pattern classification of MRI detects patterns of brain structure characterizing mild cognitive impairment (MCI), often a prodromal phase of Alzheimer's disease (AD). Detecting complex patterns of brain abnormality in very early stages of cognitive impairment has pivotal importance for the detection and management of AD. Moreover, this pattern can be detected with high sensitivity and specificity using a high-dimensional image analysis and pattern classification method that examines spatial patterns of brain atrophy in their entirety, instead of applying separate region-by-region evaluations.

8.HYBRID INTELLIGENT TECHNIQUES FOR MRI BRAIN IMAGES CLASSIFICATION

El-Dahshan, et.al,analyzed Magnetic resonance imaging (MRI) which is often the medical imaging method of choice when soft tissue delineation is necessary. This is especially true for any attempt to classify brain tissues. The proposed hybrid technique consists of three stages, namely, feature extraction, dimensionality reduction, and classification. In the first stage, we have obtained the features related to MRI images using discrete wavelet transformation (DWT). In the second stage, the features of magnetic resonance images have been reduced, using principal component analysis (PCA), to the more essential features. In the classification stage, two classifiers have been developed.

The first classifier based on feed forward back-propagation artificial neural network (FP-ANN) and the second classifier is based on *k*-nearest neighbour (*k*-NN). The classifiers have been used to classify subjects as normal or abnormal MRI human images.

9.HOMOGENEITY-BASED FEATURE EXTRACTION FOR CLASSIFICATION OF EARLY-STAGE ALZHEIMER'S DISEASE FROM FUNCTIONAL MAGNETIC RESONANCE IMAGES

Plant, Claudia, et al.analyzed the system for Alzheimer's disease which is the most common form of age-related dementia. AD-related dementia includes progressive cognitive decline and neuropsychiatric syndromes. Cognitive deficits are particularly prominent in declarative memory. Early-stage diagnosis of Alzheimer is of major importance for the following reasons: Also easily curable conditions like depression, poor nutrition and drug side effects may cause symptoms like early-stage Alzheimer. Moreover, recently some medications have been developed which successfully attenuate the symptoms and delay the progression of Alzheimer, but to be effective, they need to be applied as soon as possible. However, early-stage diagnosis of Alzheimer is very difficult since the symptoms are very mild and can easily be confounded with effects of normal aging.

10.LOCAL MRI ANALYSIS APPROACH IN THE DIAGNOSIS OF EARLY AND PRODROMAL ALZHEIMER'S DISEASE

Chincarini, Andrea, et al.provided the early clinical signs of Alzheimer's disease (AD) have been extensively investigated, leading to the concept of amnestic Mild Cognitive Impairment (aMCI), an intermediate cognitive state between normal aging and dementia. The aMCI condition is currently identified by both a reported and objective memory impairment, either associated with a slight impairment in other cognitive areas (multi-domain aMCI) and not (single-domain aMCI). In longitudinal studies the aMCI subjects are experienced either to convert to AD (converters) or not (non-converters). In the latter case they may remain stable in the aMCI state or they may even revert to normalcy. Therefore, aMCI is a clinically and pathologically heterogeneous state in need of effective and reliable strategies to predict the clinical evolution. When these are available, hopefully upcoming disease-modifying drugs will be administered only to the aMCI subjects with prodromal AD as diagnosed.

III. RESEARCH METHODOLOGY

3.1EXISTING SYSTEM

Image segmentation is an important and, perhaps, the most difficult task in image processing. Segmentation refers to the grouping of image elements that exhibit similar characteristics, i.e. subdividing an image into its constituent regions or objects. Segmentation is a fundamental process in digital image processing which has found extensive applications in areas such as medical image processing, compression, diagnosis arthritis from joint image, automatic text hand writing analysis, and remote sensing. The clustering methods can be used to segment any image into various clusters based on the similarity criteria like color or texture. In existing system, K-means clustering algorithm is implemented which divides the image into K clusters based on the similarity between the pixels in that cluster. Brain tumor segmentation deals with the implementation of simple algorithm for detection of range and shape of tumor in brain MR image. Normally the anatomy of the brain can be viewed by the MRI scan or CT scan for diagnosis. A widely used method for clustering is based on K-means in which the data is partitioned into K number of clusters. In this method, clusters are predefined which is highly dependent on the initial identification of elements representing the clusters well. And also implemented Fuzzy C means clustering algorithm. But this algorithm can't handle complex structures of brain tissues

3.1.1 DISADVANTAGES

User defined clustering is used

Segmentation accuracy is low

Noises lead to irrelevant results

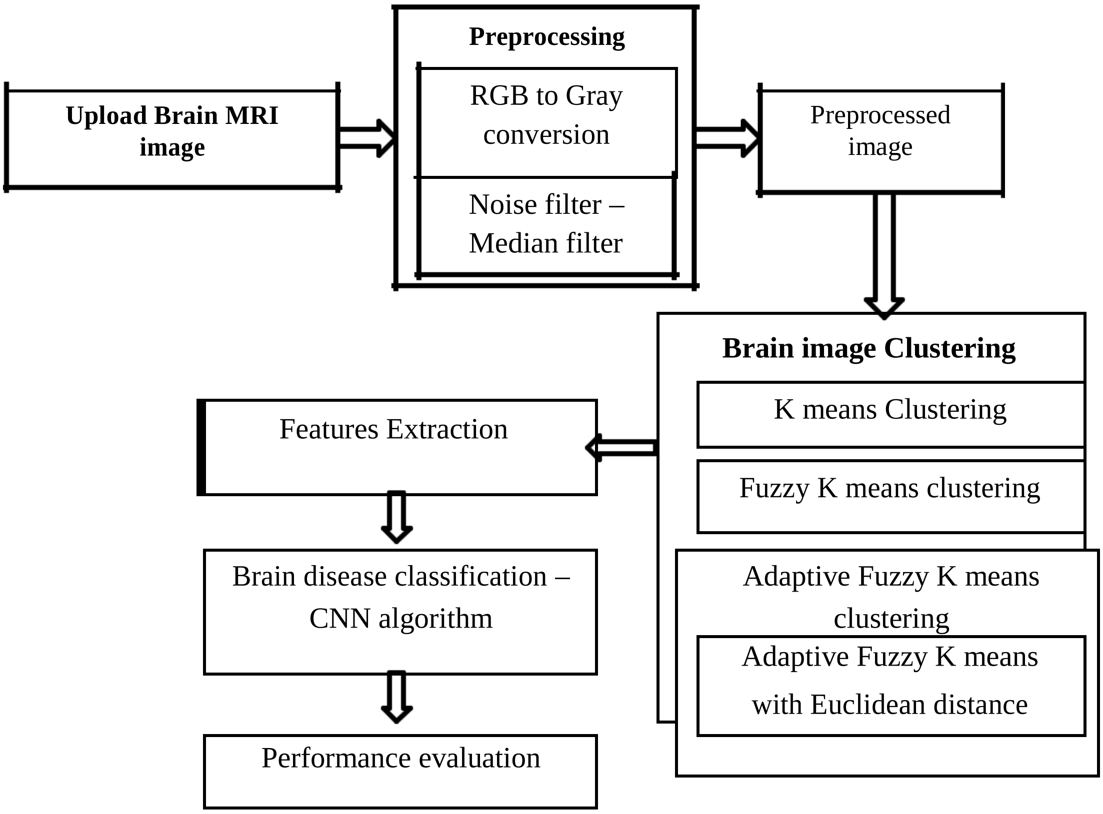
Classification can't be implemented

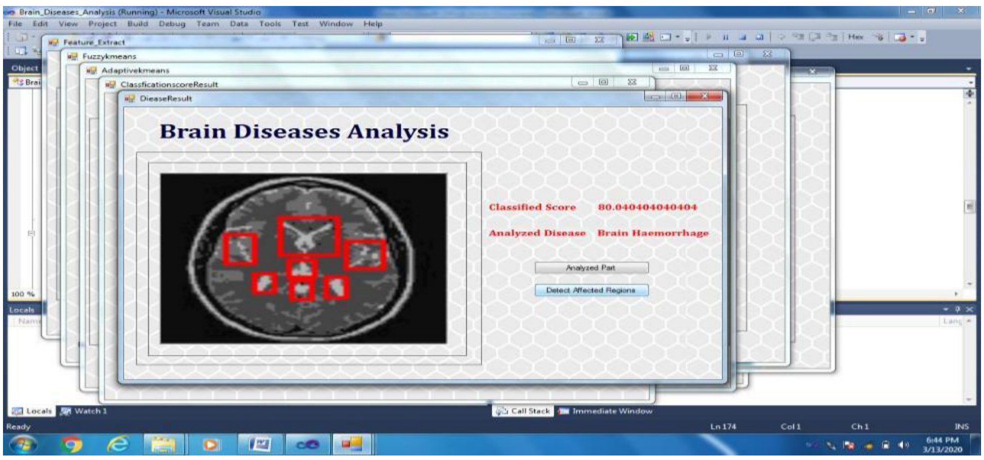
3.2 PROPOSED SYSTEM

The proposed system has mainly four modules namely Pre-processing, segmentation using Adaptive fuzzy k means, Feature extraction, and Classification. According to the need of the next level the pre-processing step converts the image. It performs filtering of noise and other artifacts in the image and sharpening the edges in the image. RGB to gray conversion and Reshaping also takes place here. It includes a median filter for noise removal. The feature extraction is extracting the cluster, which shows the predicted tumor at the fuzzy k means output. The extracted cluster is given to the distance process. The distance value measurements include Euclidean distance. Based on distance values, brain regions are clustered. It applies a binary mask over the entire image. In the distance measurements step the tumor area is calculated using the convolutional neural network method making the dark pixel darker and white brighter. In CNN coding, each transform coefficient is compared with a threshold and if it's less than the threshold value, it is considered as zero or else one. In the approximate reasoning step the tumour area is calculated using the binarization method. That is the image having only two values either black or white (0 or 1). Here 256x256 JPEG image is a maximum image size. The binary image can be represented as a summation of total number of white and black pixels. Pre-processing is done by filtering. Segmentation is carried out by adaptive fuzzy k means clustering based on Euclidean distances. The feature extraction is done by considering the threshold and finally, classification method to recognize the tumor shape and position in MRI image using CNN classification. Finally compare the results of the system using accuracy rate, error rate and execution time.

3.2.1 ADVANTAGES

- Noises are reduced by filtering
- The proposed method is very accurate to detect the tumor affected area.
- It shrinks the time for analysis
- Segmentation accuracy is high





IV. FOOTNOTES

Brain tumors are caused by abnormal and uncontrolled growing of the cells inside the brain. Treatment of a brain tumor depends on its size and location. Although benign tumors do not tend to spread, they can cause damage by pressing on areas of the brain if they are not treated early. To avoid manual errors, an automated intelligent classification technique is proposed which caters the need for segmentation of image. Image segmentation is the crucial task as medical images are concerned. The accurate segmentation is needed. This review paper gives the detail idea of brain tumour segmentation and classification techniques. Medical image processing and analysis is active and fast growing field. The image processing techniques are able enough able to process the medical image. After implement classification techniques based on Neural Networks are proposed and applied to brain image classification. Here also proposed brain tumour image segmentation based on K means, Fuzzy K means and Adaptive Fuzzy K means algorithms with two distance measures such as Euclidean distance. The proposed Euclidean distance AFKM is automated intelligent system results in the improvement of accuracy rate and reduces the error rate of MRI brain tumour with minimum execution time

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In future work, we can extend the framework to implement various clustering or classification algorithms to improve the performance of the system. And also implement deep learning algorithms to improve the accuracy in disease prediction

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