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BRAIN IMAGING TECHNIQUES FOR BRAIN TUMOR CLASSIFICATION USING ARM AND SRM TECHNIQUE

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Abstract

Functional Magnetic Resonance Imaging (fMRI) is a non-invasive way of scanning technology that provides a potential way to study brain function. Massive in volume and complex in terms of the information content, fMRI data requires effective data mining techniques. The difficulty in this problem comes from the huge number of image voxels that may provide relevant information with respect to the limited number of available images. To understand the complex interaction patterns among brain regions we propose Statistical Region Merging (SRM) technique. Segmentation of images are done using SRM technique. It is difficult to predict the tumor type with the use of metabolite value. Association Rule Mining is one of fundamental research topic in Data Mining that plays a vital role to detect brain tumor in fMRI scan. Apriori Association Rule, Predictive Apriori Algorithm Filtered Associator Algorithm are used to find out tumor type.

Index Terms—BOLD, Image segmentation, Statistical Region Merging, Association Rule Mining,

I INTRODUCTION

Conventional MRI uses a powerful magnet and radio waves to safely and noninvasively produce images of the brain or other structures inside your body. In the early 1990s, researchers thought up a new way to use this imaging technology: as a research tool rather than a diagnostic method. Putting the "f" in MRI, these researchers focus on function. Using an MRI scanner, they monitor the flow of blood to different regions of the brain as their research subjects respond to a specific stimulus—a sound, an image, evens a touch. While conventional MRI results in snapshots of what's inside the body, fMRI produces movies starring the brain.

Functional Magnetic Resonance Imaging (fMRI) opens up the opportunity to study human brain function in a noninvasive way. The basic signal of fMRI relies on the blood-oxygen-level-dependent (BOLD) effect, which allows

indirectly imaging brain activity by changes in the blood flow related to the energy consumption of brain cells. In a typical fMRI experiment, the subject performs some cognitive task. Recently, resting-state fMRI has attracted considerable attention in the neuroscience community [1].
Brain tumor is abnormal and uncontrolled growth of brain cells. Functional Magnetic Resonance Imaging (fMRI) provides detail information about brain tumor anatomy, cellular structure, making it an important tool for diagnosis[2].

II LITERATURE SURVEY

P. Rajendran and M. Madheswaran in [3] proposed association rule mining technique to classify the CT scan brain images. For
These study three categories have been taken namely normal, benign and malign. Low level feature extracted from images and high level knowledge from specialists is combined into system. hasan aydin, nilay aydin oktay, serdar spaholu, elif altin and baki hekmolu in [4] evaluated proton MR spectroscopy for brain tumor categorization. Brain tumors are classified into low-high grade glial neoplasms, menengiomas and metastasis.

T. Logeswari and M. Karnan in [5] proposed segmentation based brain tumor detection. Proposed segmentation method has two phases. In the first phase, film artifact and noise are removed. In second phase, Hierarchical Self Organizing Map (HSOM) is applied.

G Vijay Kumar and Dr GV Raju in [6] proposed early prediction of brain cancer based on texture features and neuro classification logic. Nine distinct features along with minimum distance are used for brain tumor detection in given MRI image. Extracted region is recognized using neuro fuzzy approach.

Andac Hamamci, Nadir Kucuk, Kutlay Karaman,Kayihan Engin, and Gozde Unal in [7] presents fast and robust tool for segmentation of solid brain tumors. Tool
assists clinicians and researchers in radio surgery planning with minimal user interaction.

Dina Aboul Dahab, Samy S. A. Ghoniemy and Gamal M. Selim in [8] applied modified segmentation techniques on MRI scan images to detect brain tumor. Modified Probabilistic Neural Network based on Learning Vector Quantization with image and data analysis to classify brain tumor using MRI scans. Sudipta Roy and Samir K. Bandyopadhyay in [9] proposes fully automatic algorithm for brain tumor detection using symmetry analysis. Disease progression is indicated by quantitative analysis.

III IMAGE SEGMENTATION

Segmentation is the process dividing an image into regions with similar properties such as gray level, color, texture, brightness, and contrast. [10] The role of segmentation is to subdivide the objects in an image; in case of medical image segmentation the aim is to:

- Study anatomical structure
- Identify Region of Interest i.e. locate tumor, lesion and other abnormalities
- Measure tissue volume to measure growth of tumor (also decrease in size of tumor with treatment)
- Help in treatment planning prior to radiation therapy; in radiation dose calculation

Automatic segmentation of medical images is a difficult task as medical images are complex in nature and rarely have any simple linear feature. Further, the output of segmentation algorithm is affected due to

- partial volume effect.
- intensity inhomogeneity
- presence of artifacts

Artifacts present in fMRI images can be divided into three categories on the basis of image processing technique needed to rectify them: (i) artifacts needing appropriate filtering technique. For example, noise artifact, susceptibility artifact and

presence of non-sharp edges in the image (ii) artifact needing appropriate image restoration techniques for example motion artifacts and (iii) artifact needing specific algorithm are partial volume, intensity inhomogeneity.

Statistical Region Merging is one of the best image segmentation technique in which images to fmri dataset are segmented according to voxels of the images. This approach is the direct medical application for segmentation and edge detection. A

major use of SRM is higher number of color palettes in an image are converted into lower number of palettes by merging the similar colors palettes together. The merging criteria include allowed color ranges, minimum size of a region, maximum size of a region, allowed number of platelets

We have reviewed the techniques of the fMRI image enhancement in terms of tumor pixels detected. We have studied several digital image processing methods and discussed its requirements and properties in brain tumor detection. This paper gives enhanced information about brain tumor segmentation.

Proposed system takes fMRI images as an input. Extract values from fMRI graph and store it in dataset. Dataset can be used in clustering or classification. Overall working of proposed system is shown in Fig.1.

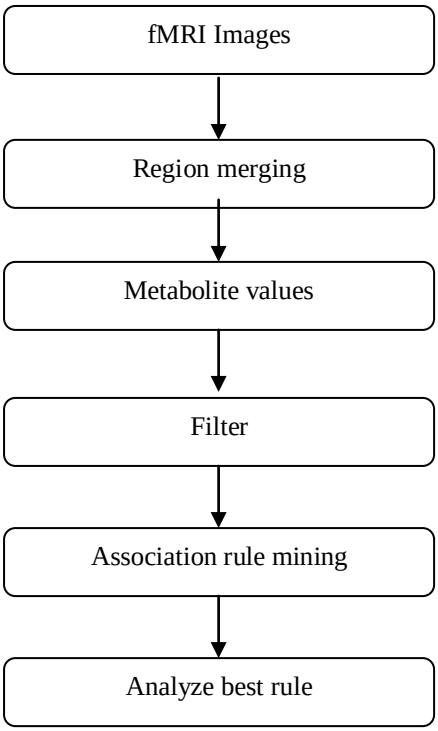

Fig. 1 Proposed System Design

PREPROCESSING

fMRI images contains metabolite values those can be used to detect the brain tumor type. Simple graph scanning method is used to extract the values from graph. Graph scanning algorithm.

1. Locate X-axis of MRI image. (X-axis is same for all MRI images i.e. in PPM with same scale)
2. Metabolite[0]=Location of 2 on X-axis as NAA metabolite always occurs at 2 PPM.
3. Metabolite[1]= Location of 3 on X-axis as Cr metabolite always occurs at 3 PPM.
4. Metabolite[2]= Location of peak next to Cr.
5. Metabolite[3]= Location of peak less than but near to 4PPM.
6. Take suitable scale value *s* from user.
7. For each *m* in Metabolite

a) Scan along Y- axis until peak point is detected on MRI graph line.
b) Compute distance between peak point and X axis.
c) Temp=distance / 115.

d) Result[*m*]=Temp × *s*.
8. End
9. Store Result array.
10. End

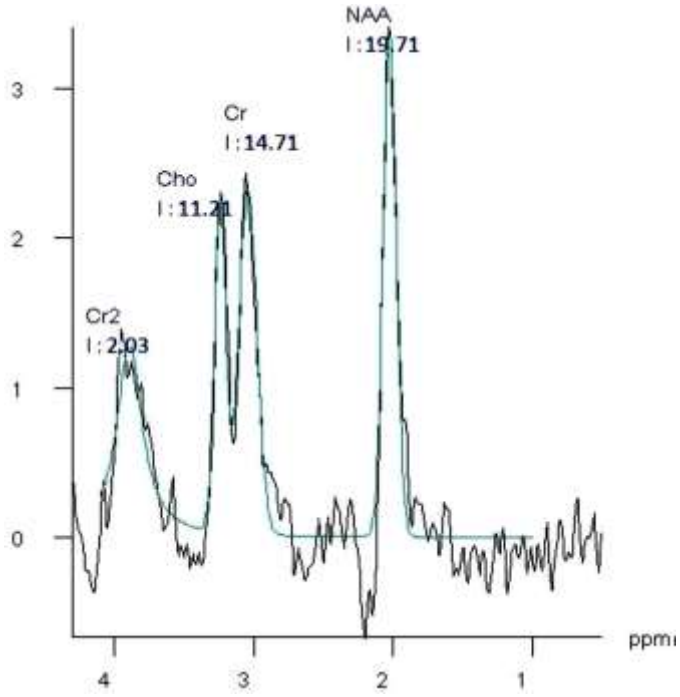

Fig 2.Sample Graph

The common way to analyse clinical spectra is to look at metabolite ratios, namely NAA/Cr, NAA/Cho, and Cho/Cr. Normal and abnormal values are shown in the chart. By including a known reference solution when acquiring the MR spectral data, absolute concentrations of metabolites can be calculated[11][12].

Table 1: Metabolite Ratios

	Normal	Abnormal
NAA/Cr	2.0	<1.6
NAA/Cho	1.6	<1.2
Cho/Cr	1.2	>1.5

From NAA, Cho, Cr and Cr2 metabolite values through which we can easily identify the tumour type like Benign, Malignant, Mild and Infection. The detail information is shown in Table 2.

Table2: Number of Instances per tumor type

Tumor	**Type Instances taken**
Benign	45
Mild	48
Malignant	49
Infection	17
Total	159

METABOLITE VALUES

MRI image contains four important metabolites namely NAA, Cho, Cr and Cr2 along with their weight. As the weights of metabolites are overlapped with graph line and images are not clear enough, so it is not possible to go for OCR technique.

	A	B	C	D	E
1	NAA	Cr	Cho	Cr2	Class
2	23.63	18	17.27	11.53	Benign
3	3.93	3.03	3.77	1.97	Mild
4	12.61	9.6	9.21	6.15	Benign
5	19.7	11.22	10	4.61	Benign
6	21.71	13.16	14.59	7.59	Mild
7	9.84	6.46	14	5.46	Malignant
8	7.52	9.43	16.62	8.29	Malignant
9	4.39	4.82	5.11	2.82	Infection

Table3: Metabolite values

IV ASSOCIATION RULE MINING ALGORITHMS

Association rule mining is being applied to search for hidden relationships among the attribute. It is intended to identify strong rules discovered in databases using different measures of interestingness[13][14]. Therefore, an association rule is a pattern that states when X occurs, Y occurs with certain probability.

4.1 Apriori Algorithm

Association rules mining using apriori algorithm uses a "bottom up" approach, where frequent item sets are extended one item at a time (a step known as candidate generation), and groups of candidates are tested against the data. The algorithm terminates when no further successful extensions are found [15][16]. The algorithm uses breadth-first search and a hash tree structure to count candidate item sets efficiently. Apriori is a two-step process, where in the first step, frequent test-sets are discovered and in the second step, association rules are derived from the frequent test-sets Quality of association rules depends upon support and confidence [17].

Candidate Generation and Test Approach

Step1: Initially, scan Database once to get frequent 1-itemset.
Step2: Generate length (k+1) candidate itemsets from length k frequent itemsets.
Step3:Test the candidates against Database.
Step4: Terminate when no frequent or candidate set
can be generated.

To select interesting rules from the set of all possible rules generated, constraints on various measures of significance and interest can be used. The best-known constraints are minimum thresholds on support and confidence.

Support

Support of an association rule $A \cup B$ is the number of transactions that contains item set $A \cup$ [1]. $support$ $A \Rightarrow B = (A \cup B)$[18].

Confidence

Confidence of an association rule $A \cup B$ is the ratio of number of transactions that contains $A \cup B$ to the number of transaction that contains A [19].

4.2 Predictive Apriori Algorithm

This algorithm generates association rule based on predictive accuracy. Predictive accuracy is derived from support and confidence. The algorithm searches with an increasing support for the best „n" rules. In weka, Predictive apriori has options like car, class Index and num Rules [20].

4.2 Filtered Associator Algorithm

Filtered Associator is a class for running arbitrary associator
on data that has been passed through an arbitrary filter. Filtered associator processes the training data and test data without changing their structure [21].

V CONCLUSION

fMRI scanning technology relies on the blood-oxygen-level-dependent (BOLD) effect, which allows indirectly imaging brain activity by changes in the blood flow.so it is more efficient of using association rule mining technique to detect tumor. The association rule mining algorithm, has established the importance of investigations and laboratory tests in assessing the degree and extent of cancer. Images are segmented according to its colours of platelets. Similar coloured platelets are grouped together in which it helps to segment the images easily. Thus it is more helpful to segment and detect tumor types. In future we can apply Fuzzy algorithm to find out the metabolite vales of the images.

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