Predictive Analysis On Brain Tissue Segmentation And Knowledge Extraction With RS-FCM Algorithm

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Abstract: In recent years, it is found a majority of human beings are affected and dies due to cancer. This is because of unhealthy lifestyle and hazardous food and chemical intake. Based on the statistical report cancer has grown double time over last 26 years. As per Indian council of medical research data 19 lakh cancer patients are reported in 2019. The major issue of uncontrollable growth of cancer is due to very late detection and treatment. The cancer can be easily cured if it is detected in the early stage. In this paper, a novel technique RS-FCM has been introduced to segregate, classify and identify the tumor in the human brain is explained in detail. The simulation result proven that the algorithm works effectively in identification of tumor.

Keyword: RS-FCM, medical image processing, segmentation, clustering image, feature extraction, MRI image, query match analyzer

1. INTRODUCTION

The digital image processing deals with the innovative approach on performing several operations over digital image to extract key features and information. This various key features pays ways for extraction of information. These information is used in many fields like medical, biometric, remote sensing, architectural and engineering designs, aeronautical engineering, satellite communications for decision making. Image retrieval is closely associated with information retrieval. By querying an image, we can obtain the information associated with it. The advancement in multimedia technology and the low price of image capturing devices has led to the increased availability of digital images. These images can be used effectively only if there is a mechanism to search and retrieve the desired result. Image based applications involve similar image retrieval as a major process. In this approach, each image in the database is segmented into regions associated with homogenous color, texture, and shape features. Using the Clustering algorithm, we cluster all the similar images and group them together and display. The images will be ranked according to the order of the relevance and retrieved. Given a sample Query image with a tag description. The Keyword for the search is extracted from the given text tag using the keyword extraction algorithm. A search process is triggered using any well-known search engine. The resultant collections of images are stored and the features are extracted for the images and stored in the image repository. The images are then clustered using the clustering algorithm. The proposed methodology retrieves all images that are similar to the given user query image based upon their relevance. The features are extracted based on the attributes like edge, color and texture. The images are then matched with the repository images and then retrieves the similar images. The fig.1 explains the algorithm works with Interface to search engine, capturing of search engine results, clustering of search engine results by Clustering Algorithm, User interface for Image based search Query, Cluster selection and Re-ranking of images. With improved technique on image processing with IT into health care system factored the medical science to gather more information. These meaning full data help the diagnosis more accurate and helped the patients with better treatment. In this research paper a novel methodology is introduced to classify and cluster the abnormal tissue and normal tissue in the human brain. The abnormal growth in the tissue may be called as tumors. The tumor may be an extra tissue growth with no side effects or with dangerous effect which may result in brain cancer. The cancerous cell is an abnormality and causes uncontrolled growth of tissue. MRI Scan is a technique widely used in many countries to detect the tumors and cancer, however, the inner tissue and unlabeled tissues may not be seen clearly and make the diagnosis very difficult in the early stage.

The RSFCM algorithm discussed in this paper will provide a wonderful solution and helps for early detection. The primitive step is to segregate, segment and cluster the MRI Scanned images. The RS-FCM algorithm utilizes the MRI image. The image is processed for improve the visibility range. The image is processed and segregated. It is often noted MRI Scanned images are added with several noise due to bias field generated during scanning. This result in addition of noise over the scanned image. This causes a critical issue while diagnosis.

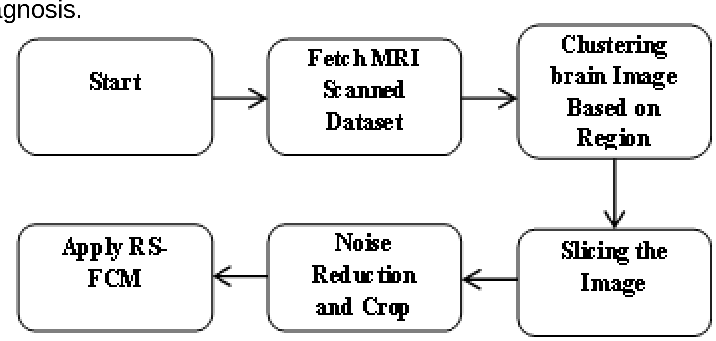

***Fig.1**. Classification and Ranking image*

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The description of image varies. The feature extraction and the computer vision applications of image processing are combined together for identifying the images which forms the basis of this approach.

2. METHODOLOGY

The methodology introduced in the paper Reduced Shadow technique over FCM algorithm. Fig.2. explains the flow of RS-FCM algorithm. RSFCM utilizes integration of several pattern identification techniques. These patterns are matched to generate very accurate scanned image. This is a respective method to analyze the labeled and unlabeled pattern continuous to remove noise and generate accurate image. Classification and clustering of brain tissue helps to differentiate the healthy tissue and infected tissue. This result can help the doctors to perform correct investigation and provide accurate medical attention. The proposed RSFCM technique is incorporated to find the hidden structure of tissue and find affected region

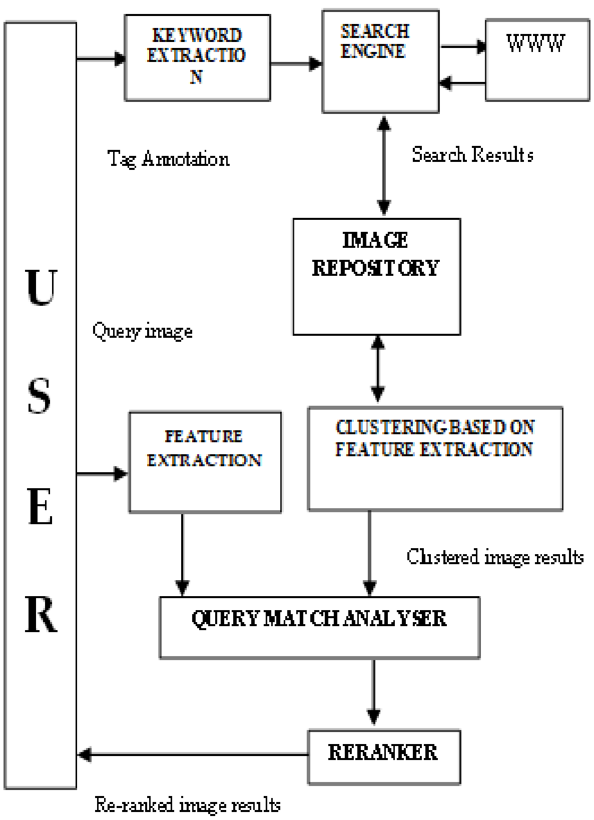


***Fig.2**. Stages of RS-FCM Algorithm*

2.1Initialization

Initially, the brain portion is segregated from the skull image. A sample image of skull usage and extracted image is listed in the fig.3.

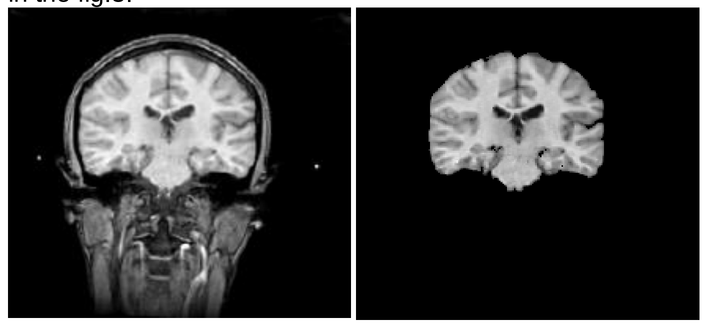


***Fig. 3**. Separation of Skull from Brain image*

RS-FCM using smothering of the obtained image is made to get the inner tissue and remove shadow and bias noise from the obtained image.

2.2 Modification on the scalar image:

Using RS-FSM algorithm, the label tissue and unlabeled tissue are segregated.

$$tissue\ T_n = \left\{ \begin{pmatrix} 1, if\ 0 < x < 1@ \\ \propto, if\ > the\ range \end{pmatrix} \right. \quad \text{(eq.1)}$$

f(x) label based on image segmentation.

$$Label\ T_n = f\big(x(t)\big) + \int_1^n x(t) + \partial\,(t) \quad \text{(eq.2)}$$

$\partial(t)$ is an experimental constant and chosen as 1.5 to normalize.

Where x is the position of tissue in the usage over a space 0 to 1 f(t(x)) which representation in deterministic law of evolution.

The image is clustered based on detection from i=1,2, 3,… C

Modified image array U

$$U = f(x) = \begin{cases} 0, & x < a \\ \frac{c}{t_n}, & x \geq b \end{cases} \quad \text{(eq.3)}$$

'a' and 'b' represents the label and unlabeled tissues in the brain image.

2.3 Process of image classification

Step 1: Initialize the obtained MRI image

Step 2: Cluster the image and calculate the mid-point.

$$\text{Mid-point evaluation} = \left(\frac{x_1+x_2}{2} \middle| \frac{y_1+y_2}{2}\right) \quad \text{(eq.4)}$$

Step 3: Compressed label (t_n) value.

Step 4: Compute modified image array U.

Step 5: Evaluate the Euclidian distance between the image point X_K and centers (V_i).

Step 6: Continue image classification until all unlabeled tissue image removed.

2.4 Process of Image segmentation and identification

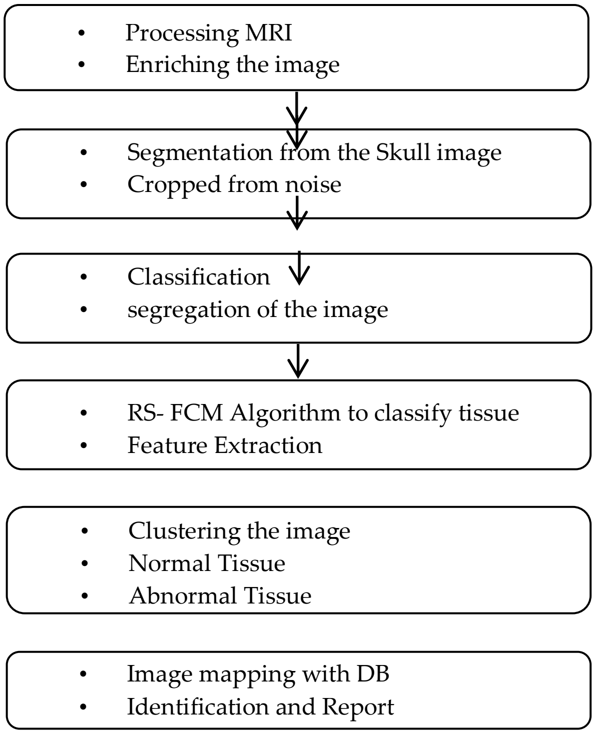


***Fig. 4**. Steps of image classification*

2.5 Processing MRI Image:

The initial step of converting the MRI image to processing and improve the quality of the image. In this step the image is validated with noise and signal ratio and validate with the available processed images. The images are smoothening and cleared the edges and remove the shadow of MRI scan.

2.6 Removing Skull:

The removal of skull image from the human brain is the main process during identification and clustering the image. The skull stripping will help to remove skull image from the brain which help to learn the tissues in much detail.

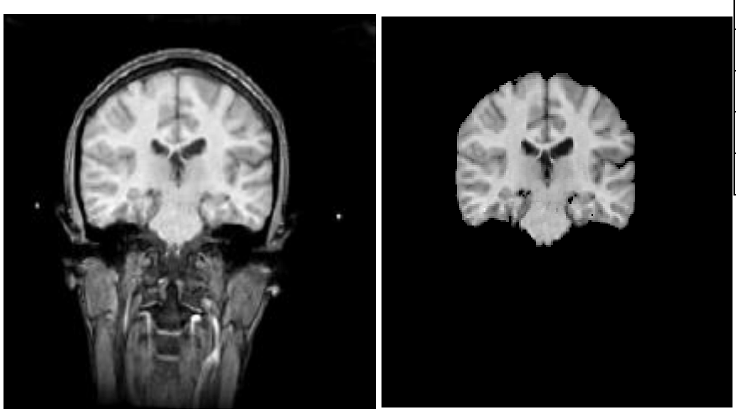


***Fig.5**. Skull removal from the brain image*

2.7 Classification and Segregation:

The affected brain is converted to binary color with range of 128. The pixel value above 128 is marked as white color and other is marked as black color. The wavelet transformation technique is executed to find the affected region with varying pigmentation on the specific region. The Berkeley wavelet transform (BWT) is a 2D image processing to find the variation in the image based on threshold. The spatial image information is converted to temporal data and it is used for evaluation.

$$\beta(x,y) = \frac{1}{y^2}\beta\left(3^y(x-i),\ 3^y(y-j)\right) \quad \text{(eq. 5)}$$

where 'x' and 'y' are translation and scale of wavelet.

2.8 RS-FCM

The RS-FCM algorithm detects anomaly in the classified and segregated data. The 2D image is represented in the form of matrix and operation is performed over the obtained matrix to determine the variation from the obtained value. The learn dataset from previously obtained images are utilized and learned with test image data. The approximate gradient value is applied over the x, y and generate the matrix.

$$U_{gx} = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

$$U_{gy} = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 1 \\ -1 & -2 & -1 \end{bmatrix}$$

The gradient value is evaluated using the modules of the function G

$$|G| = \sqrt[2n]{G_x^2 \ + G_y^2} \quad \text{(eq.6)}$$

The value of G_x and G_y helps to determine the gradient value of x and y. Based on the gradient value the algorithm helps to detect the beyond range and eliminate from the image. Using Poisson distribution, the anomaly can be evaluated and removed from the segmented image.

$$G_x = -\delta_x \Big|_{y=0} - u\int_{-n}^{n}\frac{\partial u}{\partial y}\Big|_{y=0} + \frac{\partial w}{\partial y}\Big|_{y=0} \text{(eq. 7)}$$

$$G_y = -\delta_y \Big|_{x=0} - u\int_{-n}^{n}\frac{\partial v}{\partial x}\Big|_{x=0} + \frac{\partial w}{\partial x}\Big|_{x=0} \text{(eq. 8)}$$

Where v, w are lame's constant and it I s the elastic material varies on image diagnosed.

Segmented Image	Correlation	Labeled Tissues	Unlabeled Tissues	Anomaly
S1	0.92	8.2	1.3	0.032
S2	0.95	7.8	3.2	0.043
S3	0.93	6.7	2.2	0.012
S4	0.83	7.39	3.2	0.019
S5	0.96	8.223	1.2	0.0122
S6	0.94	6.74	2.23	0.032
S7	0.98	7.423	1.564	0.112

***Table. 1**. Segmented image properties*

2.9Simulation Setup:

The simulation scenario of various segmented images are processed and analyzed using VTK tool kit incorporated with MATLAB. The images are classified and clustered with learned image and test image to identify the anomaly and classification of the tumors. For several clear identification of the tumors Brain web simulator along with MRI image database is utilized for experimental purpose. The inhomogeneity and noise formed during MRI image scanning is reduced with hologromic smoothening and reduction of shadow.

3 RESULTS AND DISCUSSION:

The experimental analysis proven that the inclusion of RS-FCM with information extraction helped to identify and extract the exact location of the tumor and helps for diagnosis. The table. Table 2 provides the data to find the image segmentation based of f(x) with modified image array U, label tissues and noise separation.

Sl. No	f(x)	U	HP (y)	Noise
1	0	0.31273	0.01948	11.8583
2	592.8571	0.3373	0.04161	12.222
3	806.8571	0.33836	0.06094	12.4888
4	920.5714	0.33869	0.07172	12.5858
5	1052	0.32816	0.08672	12.4645
6	1215.429	0.30514	0.10745	12.5615
7	1342.286	0.27959	0.12376	12.319
8	1432.286	0.25363	0.13668	12.1978
9	1534	0.21779	0.1523	12.61
10	1627.714	0.17967	0.16763	12.7798
11	1722	0.13738	0.18449	13.1678
12	1829.143	0.08236	0.20287	13.3375

***Table.2**. Image segmentation data*

3.1 Regression Statistics:

The regression testing done on the obtained results proven that the value is slightly less than 1. This is because of image reduction due to noise elimination and proven the algorithm works better.

Regression Statistics	
Multiple R	0.997360431
R Square	0.994727829
Adjusted R Square	0.993556236
Standard Error	0.004678876
Observations	12

***Table.3**. Regression statics*

3.2 Anova Statistics:

The analysis of variant and statistical method using Anova proven that the distint components are classified and absorbed to be complex value of 5.6. This is the average anomaly detection and removed from the obtained image. This helps to detect the inner tissue of the brain and perform the exclusive detection of the tumors even hide inner tissue.

	Df	SS	MS	F	Significance F
Regression	2	0.037174092	0.018587	849.0384	5.60987E-11
Residual	9	0.000197027	2.19E-05		
Total	11	0.037371119			

***Table.4**. Anova Statistics*

Two Sample Assuming Equal Variance Statistics:

The Two sample assuming vaiance analysis is performed with labelled and unlabelled tissue. It is also executed with the anomaly issue. The noise is detected to 12 % with the anomaly and when removed the variant is detected to 0.2.

	f(x)	Noise
Mean	1172.928571	12.5494
Variance	281055.8097	0.166740465
Observations	12	12
Pooled Variance	140527.9882	
Hypothesized Mean Difference	0	
Df	22	
t Stat	7.582180783	
P(T<=t) one-tail	7.10691E-08	
t Critical one-tail	1.717144374	
P(T<=t) two-tail	1.42138E-07	
t Critical two-tail	2.073873068	

Histogram of Noise detection and removal:

Fig.6. explain the histogram of noise detection and removal is done on analysed and processed image. The skull of the human brain is segregated and the noise value is remove. It is absorbed the noise is detected more on the inner tissues and the skull area. Those noise are removed and smoothen for the identification and correction.

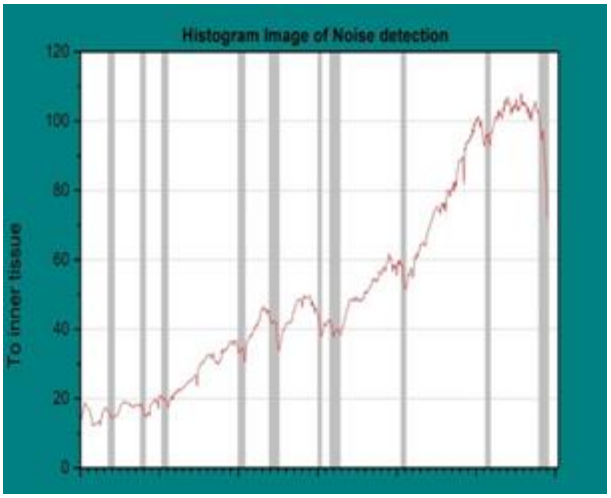


***Fig.6**. Histogram Image of noise detection*

Analysis on improved MRI for Data extraction:

Fig.7. explains the image is processed and executed with RS-FCM to remove the static bias of MRI and to detect the inner tissue of the brain. The tumor detection varies with different proportion of wavelet extracted from the segmented image. The gradient value the algorithm helps to detect the beyond range and eliminate from the image. MRI scan frequency has been increased for exact detection of the inner tissue and abnormal growth of tissue within the brain which can result in cancer cell.

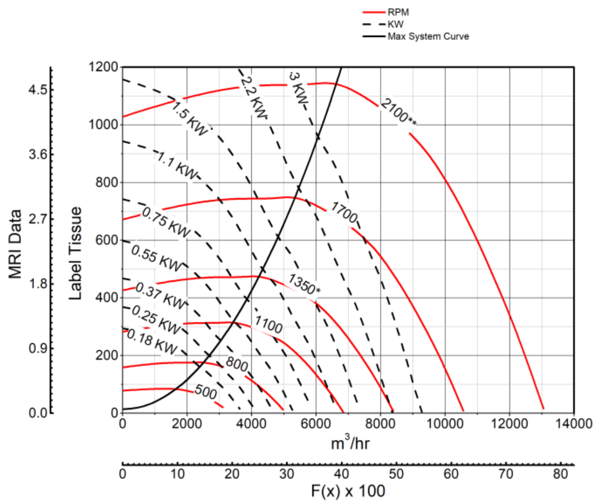
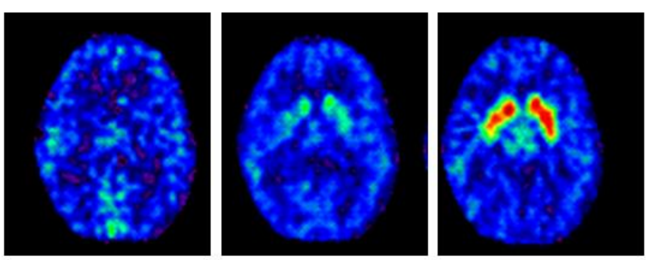


***Fig.7**. Analysis on improved MRI for Data extraction*

Conversion of images to data extraction

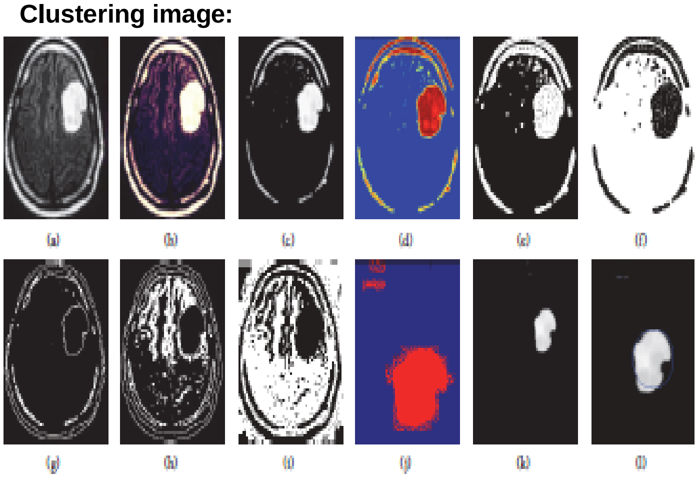
The Fig.8a. shows the processed image from error removal and identification of various abnormal growths in the brain. The Fig. 8.b. detects the anomaly of the brain and false positive gradient and identifies the exact tumors. Fig.8. c. extracts the information from the brain and provides the report to the doctor to perform the exact solution for the patient.



(a) Initialization (b) Noise reduction (c) Tumor detection

***Fig.8**. Segmented image*

Clustering image:



The Clustered image of various stages of processing of information is forecasted for the prediction. The images are classified in various stages starting from stripping the skull to detection of exact tumor location. Fig.9. explains the clustering of image.

***Fig. 9**. Clustering of image*

4.CONCLUSION:

With enormous growth in medical image processing and available datasets in various cloud repository, it become much easier and early detection of abnormalities in the human tissue. The segmentation and classification of the image is highly challenging was addressed with the help of RS-FCM algorithm. In this paper, a novel technique for clustering the human brain based on the abnormal growth and identification of tumor made easier. This result will help diagnosis much easier. However, the classification and segmentation of brain tissue is highly time consuming. The paper utilizes Gaussian method to identify and classify the image and it results with higher proximal identification. The anova and regression testing proven the algorithm is appropriate for detection. However, the algorithm should be remodeled for faster and effective analysis with minimum datasets. In the future, machine learning techniques can be incorporated for effective analysis.

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