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Clustering Algorithm for Brain Image Segmentation

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Abstract - *Brain tumour is one of the dangerous and critical disease which is even hard to get detected without any medical test for example CT Scan, MRI Scan. Image segmentation is a process that works by segregating any arbitrary image into non-intersecting regions. The regions obtained after the division should be such that each region is homogenous and the union of any two adjacent regions is heterogeneous. A new image segmentation is a method by combining the FCM clustering algorithm with a rough set theory. The rough-fuzzy c-means algorithm is presented for segmentation of brain images. The main focus of the work, based on human MRI brain image, is to optimize the segmentation process with higher accuracy rate. Cluster analysis recognizes collections of comparable objects and therefore helps in learning circulation of outlines in big data sets. Clustering is most widely used for real world applications. The effectiveness of the FCM algorithm, along with a comparison with other related algorithms, is demonstrated on a set of brain images. Rough set theory can be useful method to overcome such complication during image segmentation. Because of this we will use FCM clustering algorithm with a rough set theory.*

Key Words: **MRI Image, Brain Tumour Detection, Image Processing, Machine Learning, Clustering, Fuzzy C-means.**

1. INTRODUCTION

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of image segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of outlines extracted from the image . Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics.

Picture division is a procedure that works by isolating any self-assertive picture into non-meeting areas. The areas got after the division ought to be to such an extent that every locale is homogenous and the association of any two contiguous districts is heterogeneous. A new image segmentation is a method by combining the FCM clustering calculation with a harsh set hypothesis. The unpleasant fluffy c-implies calculation is introduced for division of mind images. The fundamental focal point of the work, in view of human MRI cerebrum picture, is to improve the division procedure with higher exactness rate. Bunch examination perceives assortments of practically identical articles and thusly helps in learning course of layouts in huge informational collections. Grouping is most broadly utilized for true applications. The electiveness of the FCM calculation, alongside an examination with other related calculations, is shown on a lot of mind pictures. Rough set hypothesis can be helpful technique to beat such intricacy during picture division. On account of this we will utilize FCM bunching calculation with an unpleasant set hypothesis.

1.1 Basic Concepts

Machine learning is a branch of Artificial Intelligent based on the idea that the system can learn from data, identify a pattern and make a decision with minimum human interaction.

Image processing is a method to perform some operations on a image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics or features associated with that image. FCM means Fuzzy C-means it is an algorithm used for clustering. Fuzzy C-means is a method of clustering which allows one piece of data to belong to two or more clusters.

2. LITERATURE SURVEY

This section of Literature Survey eventually reveals some fact of predication of students performance based on the analysis of many authors work as follows:

1. In this paper A. Namburu, S. K. Samay, and S. R. Edara [1] proposed a FCM image segmentation algorithm is to divide the sample points of vector space into C subspaces according to some distance measure. Segmenting the MRI image particularly with weak object boundaries, which is very difficult for fuzzy c-means and level set method to apply image segmentation

2. X. Yong, Z. Ji, and Y. Zhang [2] the author's goal is to Fuzzy C-means Clustering (FCM) algorithm is one of the most classical fuzzy clustering algorithms, which searches for the optimal extremes through repeated iterations. Some partitions utilized in the segmentation have an enormous impact on the output.

3. Herng-Hua Chang and Chih-Chung Hsieh [3] explains comparisons with two famous methods and evaluated on the internet brain segmentation repository (IBSR) datasets. Fully automatic methods sometimes fail, producing incorrect results and requiring the intervention of a human operator. This is often true due to restrictions imposed by image acquisition, pathology and biological variation.

4.Rosita Shishegar1,2 Anand A. Joshi3 Mary Tolcos4,5 David W. Walker5 Leigh A. Johnston1,6 [4] paper presents a new atlas-free method that segments the inner and outer boundaries of the cortical plate in fatal brains by exploiting diffusion-weighted imaging cues and using a cortical thickness constraint. Investigated the potential of deep architecture through small kernel by comparing deep CNN shallow architecture with larger filters that shallow architecture presented a lower performances.

5.Christoph Matthies, Franziska Dobrigkeit, Guenter Hesse [5] defines a parameter-efficient and practical fully convolutional neural network architecture, termed InfiNet, aimed at voxel-wise semantic segmentation of infant brain MRI images at iso-intense stage, which can be easily extended for other segmentation tasks involving multi-modalities. One of the main problems in medical image segmentation is uncertainty. Some of the sources of this uncertainty include

6. Lata Ayesha Akter and Goo-Rak Kwon [6] This paper proposed a new integrated image segmentation method for MRI brain images. In this method we have used a new transformation called Contourlet Transform which is integrated with canny edge detector. Using traditional algorithm if the boundaries of the image are blur then it becomes difficult for segmentation

7. K. Y. Lim and R. Mandava [7] The results of the fuzzy clustering are de-fuzzified, and the fuzzy clustering is transformed into deterministic classification. Problem has been to combine two or more segmentation methods in order to integrate and merge their advantages for the purpose of dealing with the different characteristics and variability of the data.

2.1 Relevant Mathematical Model

A binary masking image is established to detect large targets, which is given by formula (1). The background image can be obtained by the product of the masked image and the source image, which can be calculated by formula (2)

Bm = I >Bth.....(1)

IB=Bm×I.....(2)

Where Bm is a binary masked image, I is MR image,
B th is the threshold of image binarization. It is obtained by Otsu threshold method IB is a black background image.

$$\mu_{ij} = 1 / \sum_{k=1}^{c} (d_{ij} / d_{ik})^{(2/m-1)}$$

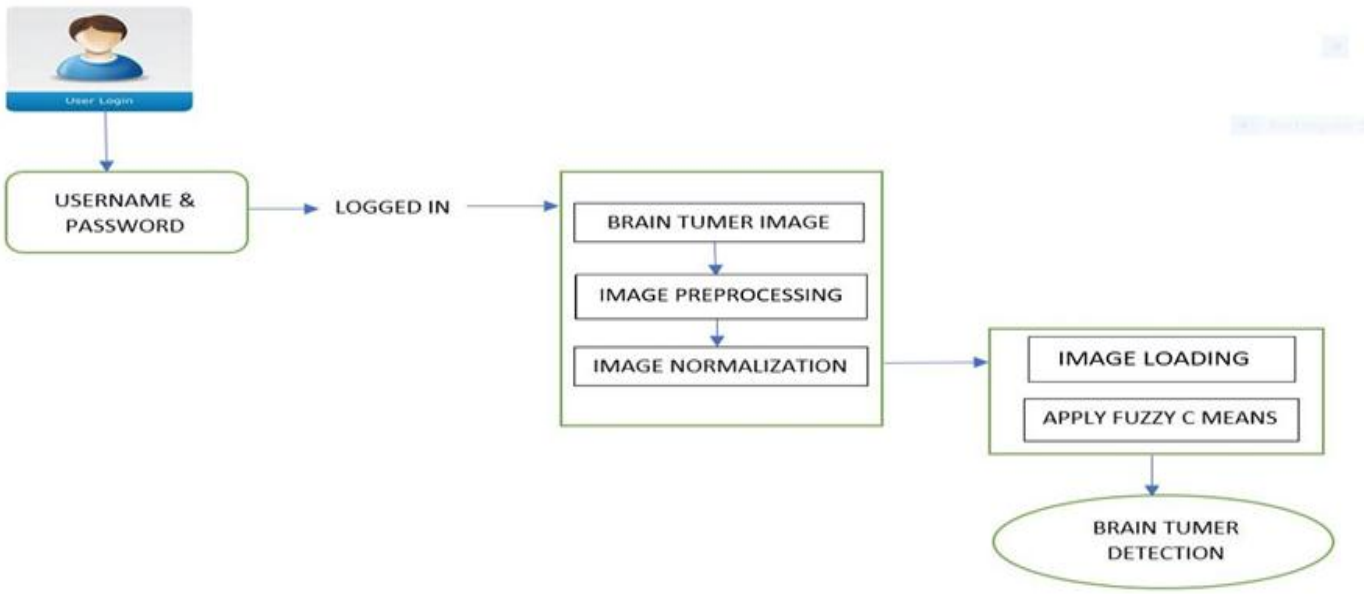
Where,
'n' is the number of data points.
'vj' represents the j^{th} cluster center.
'm' is the fuzziness index m € [1,∞].
'c' represents the number of cluster center.
'μij' represents the membership of i^{th} data to j^{th} cluster center.
'dij' represents the Euclidean distance between i^{th} data and j^{th} cluster center.
A finite set X ={x1,x2,⋯xn}is a set of n samples and c is a predetermined number of classes; m_i(I=1,2⋯c) is the center of each cluster $\mu_j(x_i)$ is the membership degree of the first sample with respect to class j. The clustering criterion function is defined as a membership function:

$$J(M, V) = \sum_{j=1}^{c} \sum_{i=1}^{m} [\mu_j(x_i)]^b \|x_i - m_j\|^2$$

Where $||x_i-m_j||^2$ is the Euclidean distance. b is a fuzzy weighted power index, which can control the degree of ambiguity of clustering results. M is the fuzzy c partition matrix of X. V is the cluster center set of X. The result of clustering algorithm is to obtain M and V which minimize the criterion function. In the method of fuzzy mean clustering, the sum of membership degrees of samples to each cluster is required to be 1:

$$\sum_{j=1}^{x} \mu_j(x_i) = 1 \quad i = 1, 2 \cdots n$$

3. SYSTEM ARCHITECTURE



Let the partial derivative of J(M,V) to mj and μj(xi) be zero. The necessary condition for obtaining the minimum is:

$$m_j = \frac{\sum_{i=1}^{n} [\mu_j(x_i)]^b x_i}{\sum_{i=1}^{n} [\mu_j(x_i)]^b} \quad j = 1, 2 \cdots c$$

$$\mu_j(x_i) = \frac{\left(1/\|x_i - m_j\|^2\right)^{1/b-1}}{\sum_{k=1}^{c} \left(1/\|x_i - m_k\|^2\right)^{1/b-1}}$$

4. ADVANTAGES:

[1] The method is simple and has advantages in processing speed, and it is suitable for the segmentation of blurred boundary areas in images.

[2] The main advantage of automating the process is that it has made the processing much less tedious and not at all time consuming.

[3] To developed will try to give best Segmentation and the detection of disease. It is having more accuracy than K-Means algorithm

[4] Gives best result for overlapped dataset and comparatively better than K-Means algorithm.

[5] Unlike K-Means where data point must exclusively belong to one cluster centre here data point is assigned membership to each cluster centre as a result of which data point may belong to more than one cluster centre.

5. RESULT AND ANALYSIS

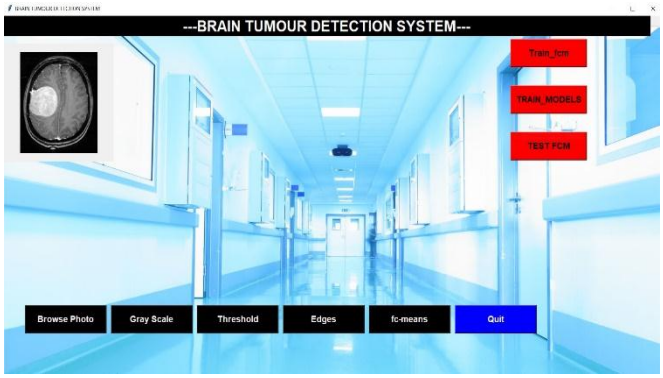


Fig.1 Browsing MRI Image

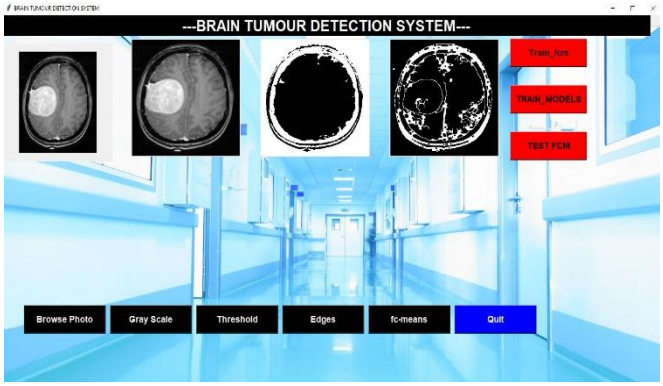


Fig. 2 Segmentation of image

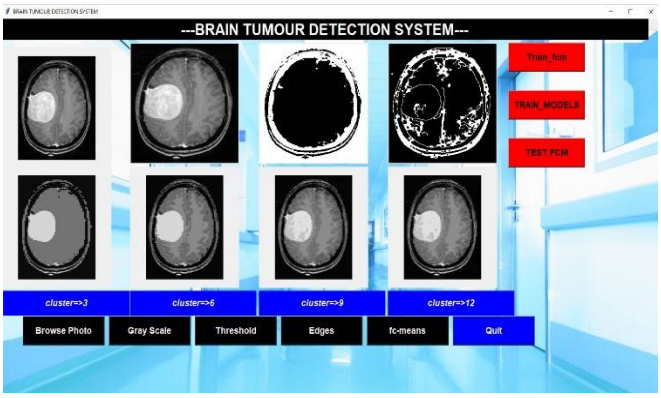


Fig. 3 Result of FC-Means algorithm on image

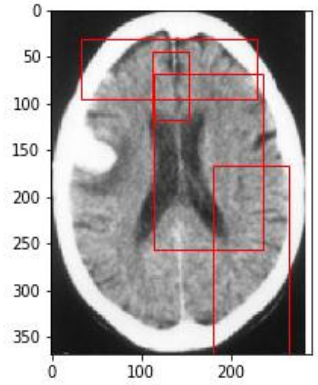


Fig. 4 Result of K-Means algorithm on image

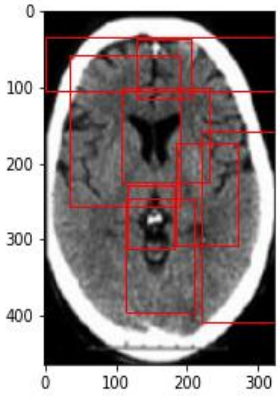


Fig. 5 Result of FCM algorithm on image

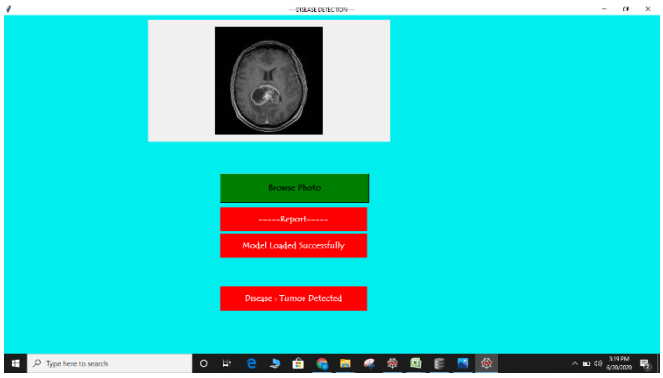


Fig. 6 MRI image Report (Tumor detection if present)

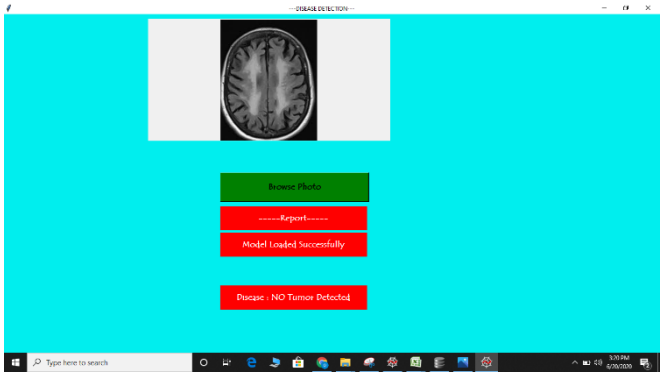


Fig. 7 MRI image Report (No Tumor detection if present)

6. CONCLUSIONS

Fuzzy C-means found great in terms of accuracy and work efficiency. Image Segmentation will improve the life style and livingness of human. It will help in medical related fields and also handle major work load of human power. Image processing is one of them. Data Pre-processing is one of the most important part of Disease Detection from image. Image Segmentation is the process of partitioning a digital image into multiple segmentation. Using fuzzy c means algorithm image segmentation become simple, fast and generate more accurate result.

7. REFERENCES

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