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Analysis of Cerebral Blood Clot in MRI Images Using Contextual Clustering Algorithm

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ABSTRACT: Cerebral blood clot can be formed due to brain injury and may cause bleeding within the brain .when clot occurs within the veins, it won't always dissolve on its own and hence it leads to very dangerous and even life threatening situation . In this paper, we propose an approach for blood clot detection using Magnetic Resonance Imaging) and separate blood clot affected regions from brain images using an optimized technique. It involves three enhancement techniques like preprocessing, segmentation and then followed by classification. Different algorithms like K-means, Fuzzy C Means and contextual clustering algorithms are executed and compared to determine an optimized algorithm for blood clot detection using image processing in an MATLAB .

KEYWORDS: Blood clot, Magnetic Resonance Image, K-Means, FCM, contextual clustering.

I. INTRODUCTION

Damaged blood vessel leads to blood clot, a major deep in our body. Due to the clot interrupting blood flow in the brain, it can cause speech issues with common affectations like slurring and stuttering. Blood clot occurs at various parts like lower leg, thigh, arm, brain, intestines, liver and kidney. But the blood clot in brain may even lead to heart attack.

When a blood clot (thrombus) or a fatty deposit blocks an artery supplying blood in the brain, it may lead to Ischemic stroke. Imaging is playing an important role in diagnosis of blood clot. Image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analogue means.

The brain imaging tests are often done in MRI. Imaging can be done by different techniques. The two major imaging techniques are the MRI and CT images. MRI images uses superconducting magnet and radiofrequency waves whereas, CT scan works by taking the multiple X-rays at various angles .MRI provides information that differs from other imaging modalities. MRI acquisitions can be programmed to encode for various physiological phenomena including velocity of moving tissue or blood, diffusion of water (useful in detecting stroke). MRI image acquisition does not use ionizing radiation. Because it requires little patient preparation and the patient acceptability is high.

Here the blood clot is detected using three different algorithms and then their outputs are compared to determine the best algorithm. K-means clustering is a type of unsupervised learning, which is used when you have unlabeled data. FCM algorithm works by assigning membership to each data point corresponding to each

cluster center on the basis of distance between the cluster center and the data point. Contextual clustering means this approach is focusing on the relationship of the nearby pixels, which is also called neighborhood.

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II. METHODS AND MATERIALS

To detect the blood clot region from the Magnetic Resonance Imaging brain images using image processing in MATLAB. There are three major steps involved for detection of blood clot region. It includes preprocessing, image, enhancement and segmentation. Algorithms like K-means, Fuzzy C means and Contextual Clustering Algorithm are used in the segmentation process. After that, we compare these three algorithms to determine the best algorithm for accurate result.

1. PREPROCESSING: a. Grey scale conversion:

Consider brain MRI scan images as input images as shown in figure 1. In order to remove the non-brain structures such as skull, bones and eyes, we are going to convert the RGB image into Grey scale image. Grey scale image is one in which the value of each pixel representing only an amount of light, it carries only intensity information. Each pixel is a shade of ray, normally from 0 (black) to 255 (white), where black represents the weakest intensity and white represents the strongest intensity. This range means that each pixel can be represented by eight bits or exactly one byte.

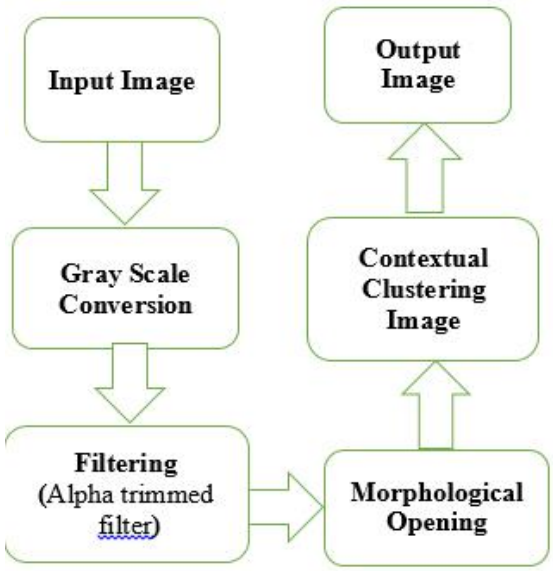

Fig.1.Block diagram of proposed method

b. Filtering:

In order to remove noise from the MRI brain images, filtering is performed using Alpha trimmed mean filter. This filter is a windowed filter of non-linear class, by its nature is a hybrid of mean and median filter. The main idea of this filter is for any element of the signal focus at its neighbour, remove the most typical elements and estimate mean values using the rest of them.

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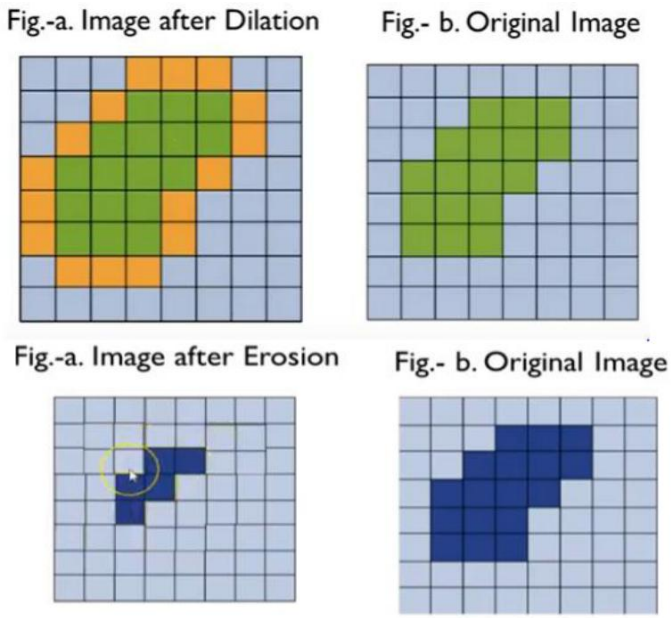
2. MORPHOLOGICAL OPENING:

Erosion followed by dilation is the morphological opening. Erosion reduces the number of pixels from object boundary of the brain images, where the number of pixels removed depends on the size of structuring element. Dilation adds pixels to the boundaries of the brain image. This process can be used to determine the specific shapes in the brain image. Opening can be used to find things into which a specific structuring element can fit (edges, corners).



3. SEGMENTATION PROCESS:

Proposed method includes three algorithms to determine the blood clot region in the brain images namely, K-means, Fuzzy C Means and contextual clustering algorithm. We determine the accurate result by comparing these algorithms.

a. K-means algorithm:

K-means clustering is a type of unsupervised learning, which is performed on the unlabeled data. This algorithm is used to find groups in the data, with the number of groups represented by the variable K. The algorithm works iteratively to assign each data point to one of K groups based on the features that are provided. Data points are clustered based on similarity.

Step 1: Get the input image

Step 2: Get K value and choose K random centers.

Step 3: Calculate Euclidean distance between each pixel and cluster center.

Step 4: Assign the data point to the cluster centers whose distance from the cluster centers is minimum of all the cluster centers

Step 5: Then re-estimate the cluster center.

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Step 6: Recalculate the distance between each data point and new obtained cluster centers.
Step 7: If no data point was reassigned then stop the process, otherwise repeat from step 3
Step 8: Final image is the k-means clustered image.

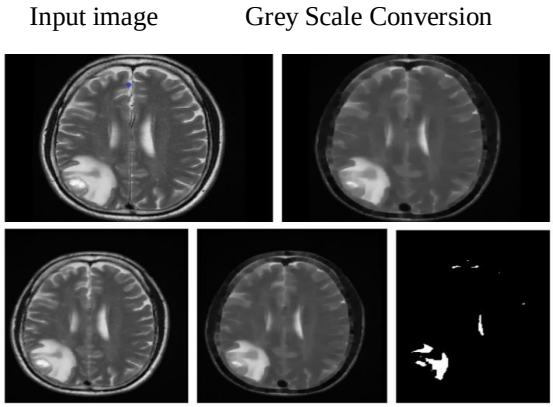

Fig.2.output of K-means

Step 5: calculate the object value. (Threshold value)

Step 6: Update the partition matrix,

$$= \sum_{=1} \left[\frac{\left(\_\_\right)^{\frac{2}{2-1}}}{\_\_\_\_\_} \right]^{-1}$$

Step 7: Check for convergence, if (u^(r+1)-u^r) <=ϵl stop the process. Otherwise return to step 3.

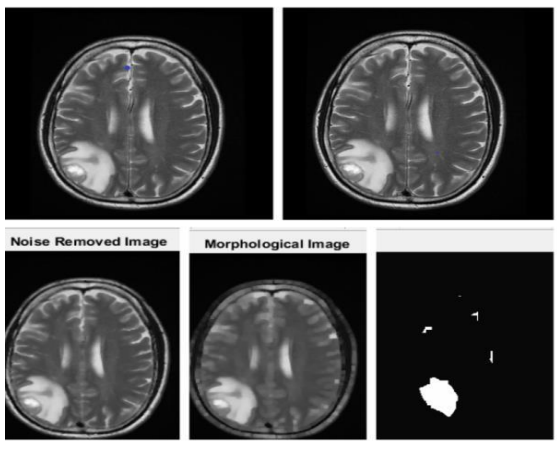

Fig.3.output of FCM

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b. Fuzzy C Means algorithm:

FCM is also called soft clustering algorithm. This algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and the data point. Here each data point can belong to more than one cluster. More the data is near to the cluster center more is its membership towards the particular cluster center.

Step 1: Get the input image.

Step 2: fix the cluster centers c (2<=c<x) and initialize the fuzzy parameter m. (value should be greater than one)

Step 3: Initialize the partition matrix u^r and assign convergence value (єl) =0.01.

Step 4: Calculate the cluster centers for each step.

c. Contextual clustering algorithm:

Contextual image classification, a topic of pattern recognition in computer vision, is an approach of classification based on contextual information in images. Contextual means this approach is focusing on the relationship of the nearby pixels, which is also called neighborhood. The goal of this approach is to classify the images by using the contextual information.

Contextual clustering algorithm segments a data into category 1 (ω0) and category 2 (ω1). The data is assumed to be drawn from standard normal distribution. The following steps are adopted for implementing contextual clustering.

1. A decision parameter Tcc (positive) is defined and weight of neighborhood information β (positive). Let

Nn be the total number of data in the neighborhood. Let Zi be the data itself, 'I'.

2. Data is classified with zi >Tα to ω1 and data to ω0.

III. RESULT-DISCUSSION

The classification is stored to C0 and C1.

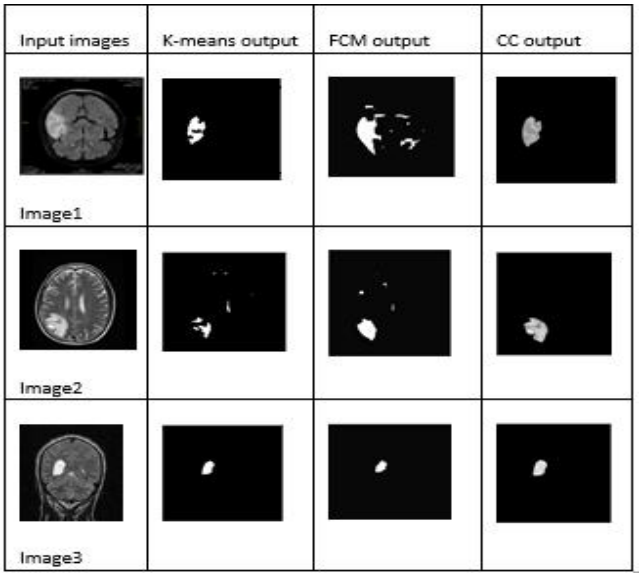
3. For each data 'i', the number of data ui is counted, belonging to class ω1 in the neighborhood of data 'I'.

It is assumed that the data outside the range belong to ω0.

$$(- \_\_)$$

4. Data is classified with $+ \frac{\quad 2 \quad}{} >$ to ω1

and other data to ω0. The classification is stored to variable C2.



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5. If C2 not equal to C1 and C2 not .equal to C0, then C1 is copied to C0, and C2 is copied to C1 and returned to step 3, otherwise returned to C2.

Step 1: Image is read and split into 3X3 windows.

Step 2: The values of the windows are sorted to form Patterns.

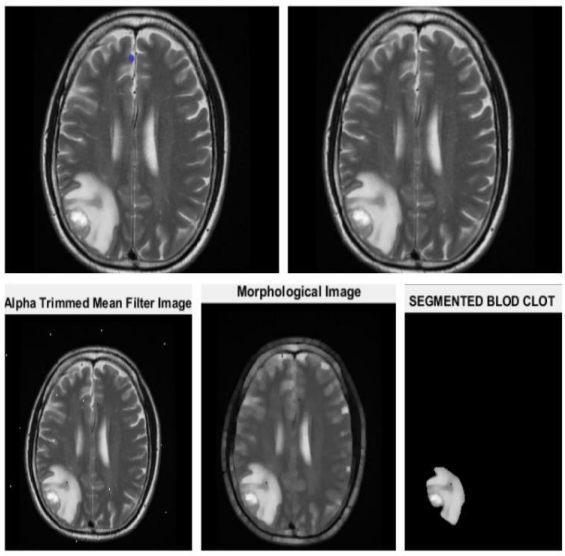
Step 3: The median of the pattern Cm is found

Step 4: The number of values greater than the median values, Um are identified.

Step 5: CC is calculated using Cm + (beta/Tcc) * (Um – (bs/2)).

Step 6: CC is assigned the segmented values.

Input image Grey Scale Conversion



Filtering Morphological image Clustering image

Fig.4.Output of CC

		K means	FCM	CC
Image1	Area	1.7e+0.3	3.16e+0.3	2.10e+0.3
	Time	135.872S	84.052S	0.46969S
Image2	Area	1834	1395	3.10e+0.3
	Time	256.340S	197.745S	0.63359S
Image3	Area	693.5	429.125	949.625
	Time	291.14S	226.08S	0.32551S

The main aim of our study is to extract blood clot region from MRI brain images using fewer algorithms like K-means, FCM and contextual clustering algorithms in MATLAB using image processing and to compare this algorithms based on Area and time to determine the best algorithm with accurate lesion detection. It includes three process namely, preprocessing, segmentation and classifications. From the above table, the output is determined that the accuracy is more in them contextual clustering algorithm when compared to FCM and K-means Algorithm. Extra cells are removed in contextual clustering algorithm. CC provides the faster blood clot detection, because it takes only minimum amount of time for blood clot detection.

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IV. CONCLUSION

The primary purpose of brain surgery is to confirm that the abnormality seen during testing is actually a blood and to remove the blood. The testing of brain images plays an important role to detect the affected region before undertaking any brain operations. In this paper, we have investigated the different algorithms for blood clot segmentation and its detection from various MRI images. MRI scan can provide pinpoint the exact location of blood clot. The different outputs are obtained based on the steps followed in each of the algorithms. The best result is obtained from Contextual clustering algorithm that is better than the other algorithms used in sense of detecting blood clots and which will help in earlier detection of the blood clot and will provide the pre treatment to the patients and thus, they can be cured.

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