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A Optimally Enhanced Fuzzy K-C Means (Oefkcm) For Clustering Algorithm Medical Image Segmentation

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ABSTRACT: Medical image segmentation is worth concepts in the fields of Biomedical and Anatomical information. The biomedical images obtained by the diagnostic equipment's are erroneous due to inception of the noise in wide band frequency. The brightness of the image is non uniform and the contrast is inhomogeneous. Hence the image thus obtained needs refinement and removal of noise and an attempt is made to enhance the region of interest by applying the image segmentation techniques. Many studies have improved more efficiency as far as subject is concerned. Numerous methods are proposed for medical image segmentation such as Clustering techniques, Thresholding technique, Classifier, Region Growing, Deformable Model, Markov Random Model, k-means, etc. Previously proposed mechanism is fuzzy k-c means in this mechanism number of cluster is lesser so the selection of number of iterations and convergence at the wrong minima. In proposed work we find out the no. of cluster by using an optimization technique of PSO and Cuckoo search technique using a Hybrid method to increase the cluster. It showed to be superior when compared to the other techniques.

Keywords: Clustering algorithm, Fuzzy K-C means algorithm, PSO, Cuckoo search, Segmentation.

I. INTRODUCTION

Medical image segmentation is vital in the field of biomedical image analysis and image interpretation for the correct and timely diagnosing of the diseases. The biomedical images obtained by the diagnostic equipment's are inaccurate as a result of origin of the noise in wide band frequency. The biomedical images have heterogeneous distinction and are having artifacts that reduces the clarity of the region of interest. The brightness of the image is non uniform and therefore the distinction is heterogeneous. Presence of visual noise provides the biomedical images a dappled, grainy, rough-textured or snowy look. A biomedical image comes from a range of sources [1]. No image is noise freed from noise however noises in biomedical images are current of noises. Hence the image thus obtained needs refinement and removal of noise and an effort is created to reinforce the region of interest by applying the image segmentation techniques. Before application of image segmentation preprocessing of images is needed. Preprocessing methods uses small neighborhood of a pixel in an input image to urge new brightness values within the output image. Such preprocessing methods are also known as filtration.

Linear operations calculate the ensuing worth within the output image pixel. Smoothing may be a methodology of suppressing noise or different tiny fluctuations within the image that is similar to suppression of high frequencies within the frequency domain. But such a technique additionally blurs the image that desires sharpening of the image at later stage. Gradient operators supported native derivatives may be used for the image perform. Image segmentation of medical specialty pictures is done by variety of strategies counting on the background intensity and threshold worth of the image pixels. Image segmentation is that the method of portioning the digital image into a multiple segments. The target of the segmentation is to change and/or modification the illustration of a picture into something more purposeful and helpful to research. The results of segmentation may be a set of segments that jointly cover the complete image. Every of the pixels within the region are comparable with regard to the number of the characteristics or computed property like color, intensity or texture. Adjacent regions are considerably totally different with regard to constant characteristics. One in every of the popular strategies embody the K suggests that cluster based mostly image segmentation wherever image is divided supported the suggestions that of the clusters with nearly same element values. The tactic of fuzzy c suggests that cluster is wide used however the method has the disadvantage of choice of range of iterations and convergence at the incorrect minima [2]. Additionally the segmentation depends upon the image intensity. So as to beat the above mentioned disadvantages an increased methodology consisting incorporation of Fuzzy K-C suggests that rule is enforced. A technique is enforced to avoid the declaration of the amount of clusters. The amount of clusters to accurately verify the amount of clusters is set by victimization an optimization technique of Cuckoo search and Particle Swarm optimization (PSO). PSO is a heuristic rule that relies on a group of birds or flocks of fishes which updates their position and speed within the search house supported the worldwide best worth. Cuckoo search algorithm is based on the replica strategy of the cuckoo and therefore the giving birth of the eggs. The determined clusters numbers are then fed to the fuzzy k suggest that rule. The

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work presents the results obtained by the hybrid PSO and CS algorithm for the biomedical image segmentation. These technologies have greatly increased knowledge of normal and diseased anatomy for medical research and are a critical component in diagnosis and treatment planning.

II. LITERATURE REVIEW

In this section, review for medical image segmentation is presented. In the modern years different schemes for giving out medical images appeared in literature [3]. Researchers have implemented many idea and techniques for segmenting and characterize the biomedical images. The use of segmentation is to separate an image into strong inter-related parts with "area of interest" in the image. Image segmentation concludes when the object of focus is divided. Segmentation can be confidential as complete and partial. Complete segmentation consequences in a set of disjoint regions corresponding absolutely with input image objects, whereas in partial segmentation resultant regions do not match directly with input image. Image segmentation is often treating as a pattern recognition problem as segmentation necessitates categorization of pixels. In biomedical imaging automated description of different image components are used, for analyzing anatomical structures such as bones, blood vessels, muscles, tissue types, pathological regions and for separating an complete image into sub regions (WM, GM and CSF).

S. Murugavalli et.al implements a neuro-fuzzy segmentation procedure of the MRI data to identify different tissues like WM, GM, CSF and tumor. To identify brain tumor a neuro fuzzy based segmentation was implemented. In terms of weight vector, the execution time and detected tumor pixels they considered the performance of the biomedical image. Then compare the results with existing method, this attains a higher value of identify tumor pixels than any other segmentation system. With additional input features this also obtains the weight vector value for the neuro fuzzy i.e. (6×6). The number of tumor cells and the execution time will also be analyzed for weight vector value with the different distance classifier methods. This also analyzes the change of growth rate of the tumor of the same patient. A Fuzzy kohonen neural network for medical image segmentation is used to analyses the tumor by extraction of the features (area, entropy, means and standard deviation).

These measurements gives a depiction for a tumor. A combined thresholding and fuzzy rule based segmentation technique [3] has been presented for analyzing MRI brain images. These methods are faster than others (FCM and Neural Networks based techniques), by using thresholding as a pre-segmentation. Also it gives a rule-based interface which can combine rules based on the experience of humans and rules learned from the measured numerical data. The outcomes of the proposed method have been compared with the fuzzy c-means algorithm on brain MRI dataset [4, 5]. For brain tumor image segmentation S. Murugavalli et. al proposed a high speed parallel fuzzy c-means algorithm to improve the performance of fuzzy c-mean(FCM) algorithm. In the segmentation techniques for clustering process, this proposed algorithm has the advantage of both the sequential FCM and parallel FCM. This algorithm is very fast when the image size is large and requires less execution time. They also accomplished less processing speed and minimizing the requirement for accessing secondary storage. In FCM algorithm, this decreases the computation cost and improves the performance by finding a good set of initial cluster centers instead of random initial cluster center. Shi juan He et. al described an MRI brain image segmentation algorithm which works in two steps. One is histogram-based fuzzy C-means (FCM) method and another is multi-scale connectivity-restrained clustering algorithm for segmenting the brain image into three major classes of GM, WM and CSF. To segment the images, histogram based FCM algorithm is used first. Then segmented result was refined by connectivity restrained clustering. The results obtained were satisfied, but this method is little complicated.

Jianhua Xuan et. Al proposed a method that unite region growing and edge detection methods for brain MRI image segmentation [5]. They start with a simple region growing algorithm which produces an over segmented image, after that a sophisticated region merging method is applied which is capable of handling complex image structures. Edge information is then integrated to validate. And wherever required, correct region boundaries. The conclusion shows that the method is reliable and efficient for MR brain image segmentation.

H.S. Prasantha et.al discussed various image segmentation algorithms. They evaluate the outputs and check which type of segmentation technique is better for a specific format. Precision and stability are the two key factors which allows for the use of a segmentation algorithm in a larger object discovery system. Ajala Funmilola A. et.al elucidate numerous methods employed for biomedical image segmentation such as Clustering, Thresholding, Classification, Deformable Model, Region Growing, Markov Random Model etc. Their work is mainly focused on clustering methods, in particular k-means and fuzzy c-means clustering algorithms. They combine these algorithms together to form another method called fuzzy k-c-means clustering algorithm, which results better in terms of time utilization. The algorithms have been proposed and tested with MRI images of human brain. Results have been examine and recorded.

III. PROBLEM DEFINITION

In existing system we use the Apriori specification of the number of clusters; no. of clusters is not specified a priori does not require the user to specify the number of cluster in advanced (unlike self organizing map or k-means clustering). With a lower value of β get a better result but at the expense of more number of iterations and

- The Euclidean distance measures can unequally weight underlying factors.
- The results is strongly depend on the initial guess of the centroids.

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- The local optimum (computed for a cluster) does not need to be a global optimum (overall clustering of a data set).
- It is not apparent what the good number K is in each case, and the process is, with respect to the outlier.

IV. PROPOSED WORK

a) Hybrid Clustering Approach

The hybrid clustering approach with the combination of PSO/CS and Fuzzy K-C means clustering is done based on the following step for a set of values to be clustered [6], and a distance (or similarity) matrix, N NxN distance (or similarity) matrix,

1. Assign every value to its own cluster.
2. Trace the nearby pair of clusters and merge them into a single cluster.
3. Calculate the distances (similarities) between the new cluster and each of the old clusters with the distance measure method.
4. Reiterate steps 2 and 3 till all genes are clustered.

b) Cuckoo search

Cuckoo search is introduced in three idealized rules: 1) Each cuckoo lays one egg at a time and dumps it in a erratically chosen nest. 2) The best nest with high quality of eggs (solutions) will carry over to the coming generation. 3) The number of presented host nests is fixed, and a host can discover an alien egg with a probability $P_a \in [0,1]$. For maximization problem the fitness of a solution can be proportional to the value of its objective functions. Other forms of fitness can be defined in a similar way to the fitness function in other evolutionary algorithm. A simple representation where one egg in a nest represents a solution and a cuckoo egg represents a new solution is used here [6]. The aim is to use the new and potentially better solutions (cuckoos) to replace worse solutions that are in the nests. When generating new solutions $x^{(t+1)}$ for, say cuckoo t, a Lévy flight is performed using the following equation:

$$x_i^{(t+1)} = x_i^t + a \oplus L\acute{e}vy(\lambda) \quad (1)$$

Where a>0 is the step size which should be related to the scales of the problem of interest. The product $\oplus$means entry wise multiplication, this studies show that Lévy flights can maximize the efficiency of resource searches in uncertain environments

c) Particle Swarm Optimization

Swarm Intelligence (SI) is an innovative distributed intelligent paradigm for solving optimization problems that originally took its inspiration from the biological examples by flocking, swarming and herding phenomena in vertebrates. PSO is an evolutionary algorithm which is inspired by the feeding birds or fish and proposed by Kennedy and Eberhart in 1955. This algorithm like other evolutionary algorithms starts with random initial solutions and begins the process to find the global optimum solutions. In this algorithm, we call each result a *particle*. Each particle moves around in the search space with a velocity [7]. The best position explored for a particle so far is recorded and is called *pbest*. Moreover, each particle knows the best *pbest* among all the particles which is called *gbest*. By considering *pbest*, *gbest* and the velocity of each particle the update rule for their position is as the following equations:

$$V_{t+1} = W_t * V_t + C_1 * rand() * (pbest - x_t) +$$
$$C_2 * rand() * (gbest - x_t).$$
$$x_{t+1} = x_t + V_{t+1}. \quad (2)$$

It is an evolutionary computation technique which is inspired by social behavior of swarms. This algorithm is the simulation of the social behavior of birds, like the choreography of a bird flock. Each individual in the population is a particle and gets a random value in the initializations. Each particle despite the position vector contains the best personal experience and a velocity vectors. The particle's velocity and its best personal experience and the global best position all together determine a particle next movement. PSO has variety of usages. CS and PSO are metaheuristic algorithms and are inspired by birds. In this paper cuckoo birds communicate in order to inform each other from the suitable place for laying egg. This is achieved by adding the swarm intelligence which is used in PSO.

d) Hybrid CS/PSO Algorithm

In this section, we explore the details of the proposed hybrid algorithm [8]. As mentioned in section 3, the nature of cuckoo birds is that they do not raise their own eggs and never build their own nests, instead they lay their eggs in the nest of other host birds. If the alien egg is discovered by the host bird, it will either throw these alien eggs away or simply abandon its nest and build a new nest elsewhere. Thus cuckoo birds always are looking for a better place in order to decrease the chance of their eggs to be discovered. In the proposed hybrid algorithm, the number of clusters is found . The goal of this communication is to inform each other from their position and help each other to immigrate to a better place.

Each cuckoo bird will record the best personal experience as *pbest* throughout its own life. In addition, the best *pbest* among all the birds is called *gbest*. The cuckoo birds' communication is recognized through the *pbest*, *gbest* and they update their position using these parameters and also the velocity of each one. The update rule for cuckoo *i*'s position is as the following:

$$V_{t+1}^{\ i} = W_t^{\ i} * V_t^{\ i} + C_1 * rand() * (pbest - x_t^{\ i}) +$$
$$C_2 * r(gbest - x_t^{\ i}).$$
$$x^i_{\ t+1} = x_t^{\ i} + V_{t+1}^{\ i}. \quad (3)$$

Where W is inertia weight which shows the effect of previous velocity vector (V_t^i) on the new vector, C_1 and C_2 are acceleration constants and rand ( ) is a random function in the range [0, 1] and x_t^i is current position of the cuckoo. It is used for determining number of clusters , then these cluster number is given to FKCM for clustering. The pseudo-code of the CS/PSO is presented as below:

begin
Objective function f(x), x =$(x_1, \dots, x_d)^T$;
Initial a population of n host nests x_i (i = 1,2,…, n);

While (t <MaxGeneration) or (stop criterion);
Get a cuckoo (say i) randomly by Lévy flights and record pbest;
Evaluate its qualitu/fitness F_i;
Choose a nest among n (say j) randomly;
If $(F_i>F_j)$, Replace j by the new solution;
end
Move cuckoo birds using equation 5 and 6;
Abandon a fraction (P_a) of worse nests
[and build new ones at new locations via Lévy flights] ;
Keep the best solutions (or nests with quality solutions) ;
rank the solutions and find the current best;
end while
post process results and visualization;
end
It is used for determining number of clusters

e) Fuzzy K-C means

In Fuzzy K-C-Means the interest is on making the number of iterations equal to that of the fuzzy c means, and still get an optimum result [9, 10]. This implies that irrespective of the lower number of iteration, we will still get an perfect result.

The algorithm has the following steps:

1. Read the image into the Matlab environment
2. Get input from hybrid technique
3. Reduce number of iteration with distance check
4. Get the size of the image
5. Calculate the distance possible size using repeating structure
6. Concatenate the given dimension for the image size
7. Repeat the matrix to generate large data items in carrying out possibly distance calculation
8. Reduce repeating when possible distance has been attained
9. Iterations begin by identifying large component of data vis a vis the value of the pixel
10. Iteration stops when possible identification elapses
11. Time is generated.

V. EXPERIMENTAL RESULTS

A variety of experiments have been performed to evaluate the proposed methodology for the analysis Medical images. The Medical Images which are collected from medical centre have been tested. The goal of this study is to increase the number of clusters reduce the time taken for clustering. In our experiments, hybrid clustering approach is employed to determine the number of cluster and then cluster the image using FKCM. The proposed researches have been implemented in Matlab (Matlab version 7.14.0). Experiment to examine the performance reliability of the fuzzy-type clustering methods is the resulted images are depicted in figure 1. The time taken number of clusters of proposed hybrid clustering based methodology is compared with fuzzy c means and fuzzy k c means clustering techniques and are depicted in table. 1 and 2

Table 1: Comparison of Time computation results on different images

ALGORITHM	TIME TAKEN (in sec) Image 1	TIME TAKEN (in sec) Image 2	TIME TAKEN (in sec) Image 3
Fuzzy C Means	26.3412	37.50179	21.473
Fuzzy K C Means	21.39067	27.77023	15.31553
OE Fuzzy k C Means	5.9335	8.763563	5.6078

Table 2: Comparison of no. of Clusters on different images

ALGORITHM	No. Of Cluster Image 1	No. Of Cluster Image 2	No. Of Cluster Image 3
FuzzyC Means	3	3	3
Fuzzy K C Means	3	3	3
OE Fuzzy k C Means	6	8	7

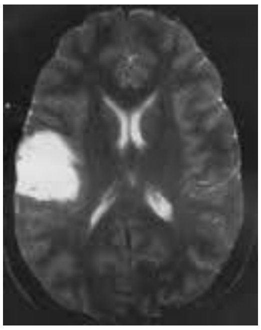


Fig 1: original image

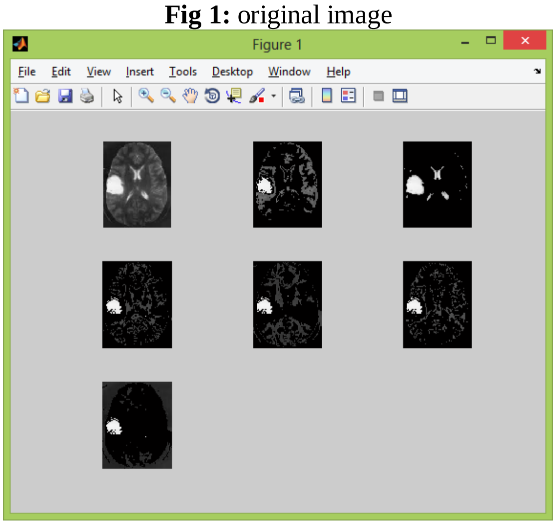
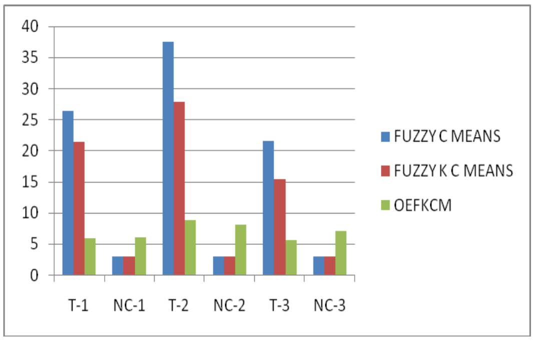


Fig 2: Comparison of results

For testing purpose we taken image which indicate the optimally enhanced method outperforms other two methods in terms of number of clusters and computational time. Depending upon the image there may be number of clusters which are very useful in image segmentation, this proposed method helps us in identifying the number of clusters and reducing the distance measurement, which is main basics for time reduction and increasing the number of clusters. These technologies have greatly increased knowledge of normal and diseased anatomy for medical research and serves as a critical component in diagnosis and treatment planning.



T-Time taken NC-No of Clusters
Fig 3: Comparison of results for three medical image

Here the result of three techniques, compared first is Fuzzy C-Means, by using the Fuzzy C Means time taken is high when compared to other because in Fuzzy C-means the no .of Cluster is in decreased level, by using Fuzzy K-C means the no .of cluster is little high when compare to Fuzzy C-means. Fuzzy K-C-Means is a method generated from both fuzzy c-means and k-means but it carries more of fuzzy c-means properties than that of k-means. Fuzzy k-c-means works on grey scale images like fuzzy c-means, generates the same number of iterations as in fuzzy c-means. , by using our technique the No .of cluster is high so we can easily segment the image and we get good results in terms of segmentation.

In terms of accuracy, the number clusters is taken into account. The more number of clusters the more number of accuracy for segmentation. In terms of other two methods the numbers of clusters is less which mainly depends upon the distance metric, here the optimization technique plays important role for increasing the results for segmentation.

VI. CONCLUSION AND FUTURE WORK

We know that clustering gives the best performance in all research proposals in present time but some cases if we enhanced the clustering techniques, which gives the better performance. Clustering gives the best performance in unsupervised learning. In proposed approach our algorithm Optimal Enhanced fuzzy k c_ means clustering (OEFKCM) will provide better result when compared to fuzzy k c means clustering by avoiding the looping problems and reducing the time. OEFKCM clustering advantages algorithm has fast converges in a few iterations regardless of the initial number of clusters.
By using our technique it reduce the looping problem, reduces of time computation, then we achieve the fast convergence. The future work involves classification of the segmented region .In the clustering approach the image is clustered into many parts, it may contain white matter gray matter and tumor etc. The tumor part must be identified and classified to which category it belongs. For classification Guassian Mixture Model can be used.

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