Brain Tumor Detection using Fuzzy C-Means Based on PSO

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Abstract— **Today's latest medical imaging study features the dispute of distinguishing brain tumor throughout Magnetic Resonance Images (MRI). In detection of brain tumor, segmentation of image is requisite. Performing this process automatically is a complicated job for the reason that of the elevated mixture in the manifestation of tissues present in tumor amongst dissimilar individual patients in addition to in numerous cases likeness among standard cells substantial segmenting of medical copy besides the radiologist is a tedious and drawn out process. In recent years, researchers from different disciplines ranging from medical to mathematical and computer sciences have combined their knowledge and efforts to better understand the disease and to find more effective treatments. Close at hand there are wide-range of segmentation methods and detection brain tumor to distinguish and division of brain tumor as of from MRI imagery. Algorithm is well calculated precisely and largely considerable but complicated parts of procedure of distinguishing brain tumor. A range of method and algorithms were designed meant for segmentating of MRI imagery by using diverse algorithms. Currently in this paper, we have projected a Particle Swarm Optimization to perk up the effectiveness of Fuzzy C-Means Clustering used to spot brain tumor all the way through MRI image.**

Keywords: Brain Tumor, Magnetic Resonance Image (MRI),PSO, Segmentation, Clustering

I. INTRODUCTION

In the diagnosis of the brain tumor ,the doctors incorporate their knowledge in the medical field and the brain anatomy in the MRI scans while obtaining the character and the and medical characteristics of brain tumor to ultimately decide the treatments required for the same.conversely in the MRI scan of Brain wherein the large amount of scans are taken from the each and every patients ,manual detecting and then later on segmenting it from the tumor affected regions becomes dull and repetitive, hence there is the necessitates of computer vision for detecting the brain tumor and segmenting it from the MRImage, so thus we prevail over the difficulty concerned while manually detecting of tumor.various algorithms were proposed recently for breakthrough but there are no expected methods which are used by the doctors in the medical background owing to the factors related to the accuracy levels and the stoutness concerns.

AI methods which corresponds to the artificial intelligence like as DIP when the mutually using with others such as contraption knowledge ,fuzzy logic systems and the recognitions of patterns are very much important and helpful in image processing techniques. The foremost goal of this paper is to develop methods and algorithm for the automatic segmentation of the brain MRI design.

The following paper organization is as follows the previous works and the shortcomings are decribed in Section II. Section III gives us the details from where the data base is taken from for the analysis. In Section IV preprocessing methods and enhancements techniques are considered. Section V gives us the informations about the FCM segmentation .and later on Clustering techniques using PSO in described in Section VI.

II. PREVIOUS WORK And Its DISADVANTAGES

Previously the refereed papers have discussed about how the segmentation of the brain tumour is the very tiresome and recurring profession. As in the individual's brain consists of a mixture of tissues and cells which can also been seen in the MRImages ,so it's the most difficult parts to detect the brain tumour correctly and efficiently. The shortcomings' in the previous work was the were able to detect the tumours but the efficiency level and the segmentation accuracy was not up to the mark and hence the time requisite for the computation progression while correctly determining the tumor was very high. The most algorithms used in the segmentation was the k-means, ACO techniques, of FCM-ACO were recently used. There was the most probability of a quantity of parts of tissues and the swelling internal to be classified as timorous region.thus we are developing the basic computer vision system in which the segmentation of the brain images is done .various segmentation methods were already incorporated for MRI. One of which the FCM was most suitable for tumour detection .and later on the performance of the FCM is increased using the optimization methods in our case it is PSO

III. IMAGE ACQUISITION

Accessing the real medical images in order to carry out the research work is very difficult due to the technical hurdles .The MRI data is been obtained from open data sourcehttp://www.cancerimagesarchives.net/display/public/collections.

Fig 1. Acquired image

IV. PREPROCESSING AND ENHANCEMENT:

The preprocessing methods and the enhancements techniques are applied to improve and enhance the detection of the tumorous region from the MRImages. Section gives us the image enhancements based on the gradient based techniques for the brain tumor which is the 1st derivative and information used are the locals. Two methods are used in this as firstly removing of the patients name alons with the consulting physician, x-rays' markings with the help of the algorithm called tracking. And secondly the removing of the higher frequency component. Thus giving us the far above the ground resolution of MRImages. Thus there by the presentation of the projected system is calculated with the help of the psnr. Here I m using the Histogram Equalisation as this is the one of the majorly critical part in several image processing techniques. Histogram equilization can be used in various images or just the portion of the image later on it helps us to improve the visual appearance of an image apart from that the PSNR ration is comparatively more as compared with the different techniques.

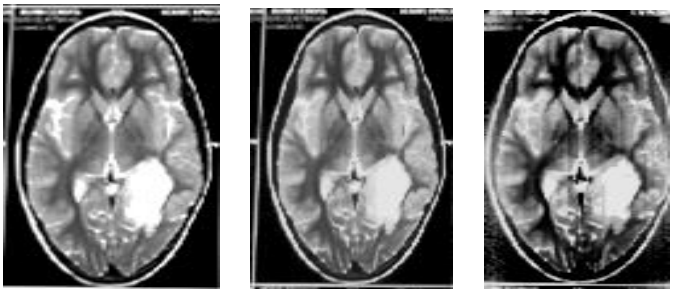

Fig. 2 Pre-processing and Enhancement

V. SEGMENTATION METHODS:

This while segmenting the image is the main step and the other most decisive part is the analyzing the image. The main objective of this is in extraction of the image particulars from the given segmented image. This method has its own concerned in the various functions in the areas of treating the patients and then making the plans for the computer based surgery. There are three main types of the segmenting the image as thresholdings , edge base and region base

The process of clustering comes under region split and merge methods of segmentation.

VI. CLUSTERING TECHNIQUES

Learning task is the basically nothing but the clustering in which one needs us to recognize the particular set of the class known to us as the cluster with the particular pixel. I n the clustering process it is mainly uses the given module. Then it is compared with bear a resembling to the criteria which is defined over the pixel. Later on the equivalent pixels are then grouped forming one cluster. High quality of th clusters are with the higher intraclass producing the superior quality of the cluster. This depends on the comparable technique using this method along with the achievements. The distinction in this technique is then being able to measure by the capability in determining clusters. Classify the particulars into the sets is the basic criterion of the clustering. In this there is the endeavour in extracting the given vector from the image. The paradigm process in the cluster making is conveying each and every pixel to the adjoining cluster. This clustering technique is the classified as the K means, Fuzzy c means.

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1) FUZZY CLUSTERING

In the fuzzy models and with recognitions of the patterns this fuzzy method is efficiently used. Depending upon the database and the various applications this numerous similar methods are used in identifying the various classes. Mainly used are in the analyzing the data, recognitions of the patterns and also in the image segmentation. As in this method this symbolize the connection amongst data which is the input pattern and their clustering, this is considered the most capable algorithm of all. This is the most popularly called as the soft clustering algorithm. Whereas the hard clustering technique it was not flexible as compared to this fuzzy c means. In the clustering form each and the every pattern feel right and purely one cluster while approaching to the partition generation. This dislocates the clusters formed in hard clustering techniques. With the help of the membership functions the particular concept in connecting the patterns with every cluster forming is achieved greatly with fuzzy clustering. Partitioning is not the usual output which we get in this form but the total clusters are achieved

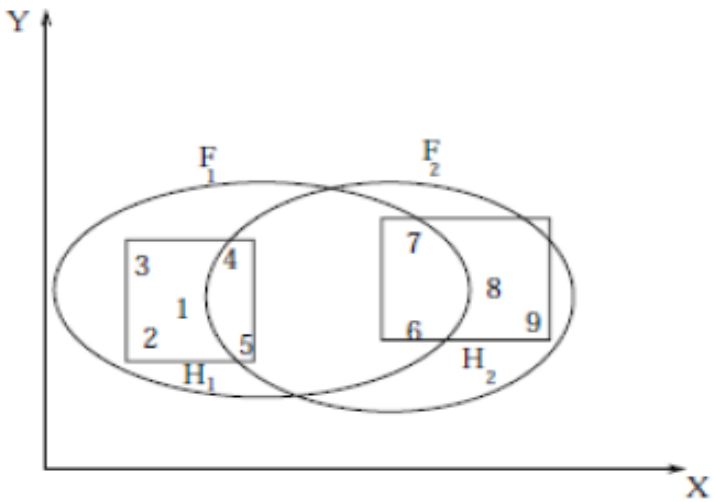


Figure 3. Fuzzy clusters

Step1 : Initialize U=[u_{ij}] matrix, $U^{(0)}$

Step2: At k-step: calculate the centers vectors $C^{(k)}=[c_j]$ with $U^{(k)}$

$$c_j = \frac{\sum_{i-1}^{N} \cup_{ij}^{m} . xi}{\sum_{i-1}^{N} \cup_{ij}^{m}}$$

Step:3 Update $U^{(k)}$, $U^{(k+1)}$

$$u_{ij} = \frac{1}{\sum_{k-1}^{c} \left(\frac{||xi-cj||}{||xi-cj||} \right)^{2/m-1}}$$

Step4: If $|| U^{(k+1)} - U^{(k)} ||< \mathcal{E}$ then STOP; otherwise return to step 2.

Figure 4. Pseudo code of the FCM[11]

2) PSO-BASED CLUSTERING ALGORITHM

Partical Swarm Optimization is based on the basic swarm intelligence technique which is been build up on the adaptation of the grouping behaviour in which the food is searched through the sources. Partical is the search space which the bird searches the solution in the particle swarm algorithm. Each particals has their own fitness values which are evaluated in the form of the fitness functions and also data in the form of the velocity which then results to the orientation in their scrap fights. The particles which are moved are in the form of the majority constructive resolution in given problem space.

The main algorithm which starts while grouping the arbitrary particles generating the particular solutions having the optimal value is the scrutinized with the help of the regular iterations. Iteratively every particles are then updated accordingly to the 2 most excellent values. The first one is called as the values which are found by the particles so extreme. Called as the " pbest". And the second effective value is determined with the population in the particles values this is termend as the globalbest in terms of the population "gbest".

This optimization is in the form of the numeric based optimization nature. On the other hand one proposed that this cluster forming can be applied while in segmenting the image. By using the population searching techniques the center of the clusters is defined using the optimal solutions with the help of these optimizations. Hence while comparing it with the other traditional technique preliminary situation is lessen.

VII. EXPERIMENTAL RESULTS

This simulation is then made in the MATLAB software. While parameters that are used are as time required along with the accuracy of systems. With the help of the FCM and PSO the results are obtained as shown.

a) SEGMENTATION RESULTS

MRI image segmentation using Fuzzy C-means and PSO. Then the time and affected pixels are given

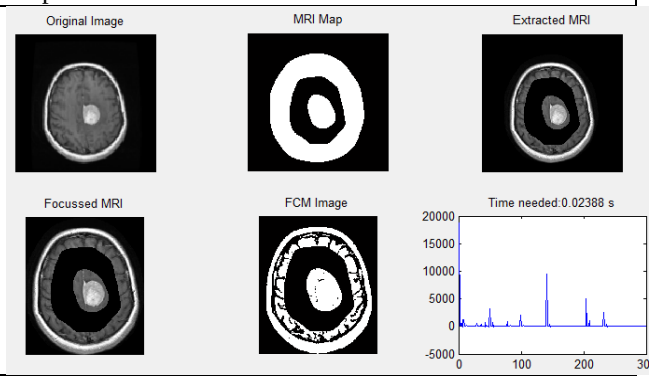
	Outputs of FCM and PSO
1.	

Table 1.Sample Segmentation using FCM

b) PERFORMANCE OF FCM AND PSO

Sr.no	Time (Sec)	Affected Pixels(no.)	SA(%)	Cancerous /Non-Cancerous
1	0.0223	47682	95.7266	C
2	0.0223	45291	96.7122	C
3	0.002	47682	92.7222	C
4	0.0242	8034	92.5422	C
5	0.0334	58526	91.3256	C
6	0.0123	82011	96.2753	C
7	0.0143	42277	95.2364	C
8	0.0043	42357	98.2352	C
9	0.0342	42399	99.7237	C
10	0.0034	42242	95.2153	C
11	0.0123	39423	92.1276	C
12	0.0223	33524	92.1782	C
13	0.0323	34959	93.1289	C
14	0.0123	34494	95.1821	C
15	0.0452	48963	98.7169	C
16	0.0283	39682	99.2163	C
17	0.0198	46893	93.1825	C
18	0.0183	46672	90.5422	NC
19	0.0321	89623	95.2396	C
20	0.052	72352	93.4322	C
21	0.0211	57263	94.21873	C
22	0.0522	74538	96.93287	C
23	0.0023	83625	97.2387	C
24	0.0423	72521	98.1279	C
25	0.0532	17165	96.126	C
26	0.05215	73532	93.1237	C
27	0.02043	84624	92.1296	C
28	0.05209	82615	93.21893	C
29	0.0423	41511	99.2312	C
30	0.0162	5261	94.21387	C
31	0.0183	7522	95.21412	C
32	0.0472	61514	96.3241	C
33	0.0728	9721	93.124	C
34	0.0121	76252	95.2442	C
35	0.0672	9171	96.2352	C
36	0.0823	-	98.32542	NC
37	0.0193	-	96.3242	NC
38	0.003	-	97.32423	NC
39	0.0563	-	93.5324	NC
40	0.05621	-	97.452	NC

41	0.05637	-	97.4523	NC
42	0.0173	-	98.5324	NC
43	0.0723	-	96.432	NC
44	0.091	-	93.3423	NC
45	0.05342	-	91.5342	NC
46	0.05243	-	90.532	NC
47	0.01723	-	91.5234	NC
48	0.0261	-	99.432	NC
49	0.0251	-	98.5324	NC
50	0.0251	-	96.532	NC

Table 2. Performance Analysis of FCM and PSO

The algorithm were tested on 50 images of cancerous and non cancerous images out of which 35 images used were cancerous and 15 were non cancerous the correctly detected images were 49.then the total accuracy of the system is been calculated and then tabulated in the form given below

Type	Correctly Detected Images	In Correctly Detected Images	Accuracy
Cancerous (35/35)	34	1	97.14%
Non Cancerous (15/15)	15	0	100%
Total Images (50)	49	1	Mean Accuracy 98.57%

Table 3. Results for Correctly Detected Images and Accuracy Level of Algorithm

	FCM	FCM with ACO	FCM with PSO
Time	32.5012 sec	83.3450 sec	35.8287sec
Accuracy	34.0088 %	97.0032%	98.57%

Table 4. Comparison between FCM and FCM with PSO

VIII. CONCLUSION

There were various difficulties while we segment the image as the brain structure obtained is very intricate and not smooth imagery. Thus for the defined detection suitable algorithm is used. Hence with the help of the FCM it is fast means of cluster formation and with the help of the optimization using particle swarm we hav found the rise in the time along with the accuracy.

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