ISSN(Online) : 2456-8910
International Journal of Innovative Research in Applied Sciences and Engineering (IJIRASE)
Volume 2, Issue 5, DOI: 10.29027/IJIRASE.v2.i5.2018, 298-301, November 2018

Identifying various type of Pathologies in Magnetic Resonance (MR) Image using Jaya algorithm

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***Abstract*—Tumor diagnosis play a significant role in the medical field. The task of identifying the tumor leads to more critical because of more complexity in the structure and size of the cancer cell. The recommended Jaya algorithm can be used for clustering and produced improved result in segmenting the tumor region. Jaya algorithm produces optimal solution for constrained problem by identifying the best and worst solution for all subset. If the solution provided is better than the previous one then the new one is updated otherwise it will take the previous one for consideration. These techniques delivered a prominent result for tumor having different boundaries and complex structures. The results obtained from jaya algorithm are compared with conventional algorithm like particle swarm optimization (PSO) clearly shows quite improved that can be used to identify various pathologies in magnetic resonance (MR) image.**

Keywords—Particle Swarm Optimization (PSO), Jaya clustering, Magnetic Resonance Image (MRI).

I. INTRODUCTION

The tumor grade can be mentioned based on the grade .If the tumor is diagnosed as malignant then immediate care should be done for the patients. Another benign type of tumor can spread slowly and it is also called as low risk grade type. But the malignant type is high risk grade type of tumor. The recommended Jaya algorithm is used to identify the various types of tumors with different structure and with different grades. This technique will help the surgeon to recognize the tumor with different shapes and to perform the segmentation in quick duration. The Jaya algorithm is used to perform better clustering than the conventional techniques. By identifying the best and worst solutions. Finally the optimal solution is attained by these techniques. The decision can be made better and more exact by incorporating the jaya algorithm to the segmentation process.

II. RELATED WORKS

S. No	Author's Detail	Proposed techniques/utilized methodology	Benefits of the proposed methodology/algorithm	Demerits of the techniques
1.	Rupali S. Kamathea et al (2018)	A novel technique is developed for demarcating the gray and white matter in MRI.	Alzheimer type of pathology identified by the recommended techniques	The author focused only on Alzheimer type of pathology.
2.	Alexis Arnaud et al (2018) [1].	Lesion in MRI can be identified by the suggested techniques.	Different types of lesions located in the image can be identified by the suggested techniques	The similarity index obtained by the techniques can be improved to higher level.
3.	Saravanan Alagarsamy et al (2017) [12].	The author used the feature of cuckoo for search and clustering is done by fuzzy for segmentation.	Different type of tumors is located in MRI by the suggested technique.	The validation process can be extended towards for more number of images.
4.	Angulakshmi M et al (2018) [11].	Spectral Clustering techniques is used by the authors	Edema portion are precisely segmented	The validations can be done with more number of images.
5.	Govindaraj et al (2014) [16].	Fuzzy C-means techniques is used by the	The proposed algorithm located the tumors in	The elapsed time for performing the

		authors	different axes of image are used	segmentation can be reduced

III. PROPOSED METHODOLOGY

A. JAYA ALGORITHM

Jaya is mainly used to solve optimization problems based on the population oriented. It produces optimal solution for the unconstrained problems. The idea of this technique is to find the optimal solution for the specific problems.

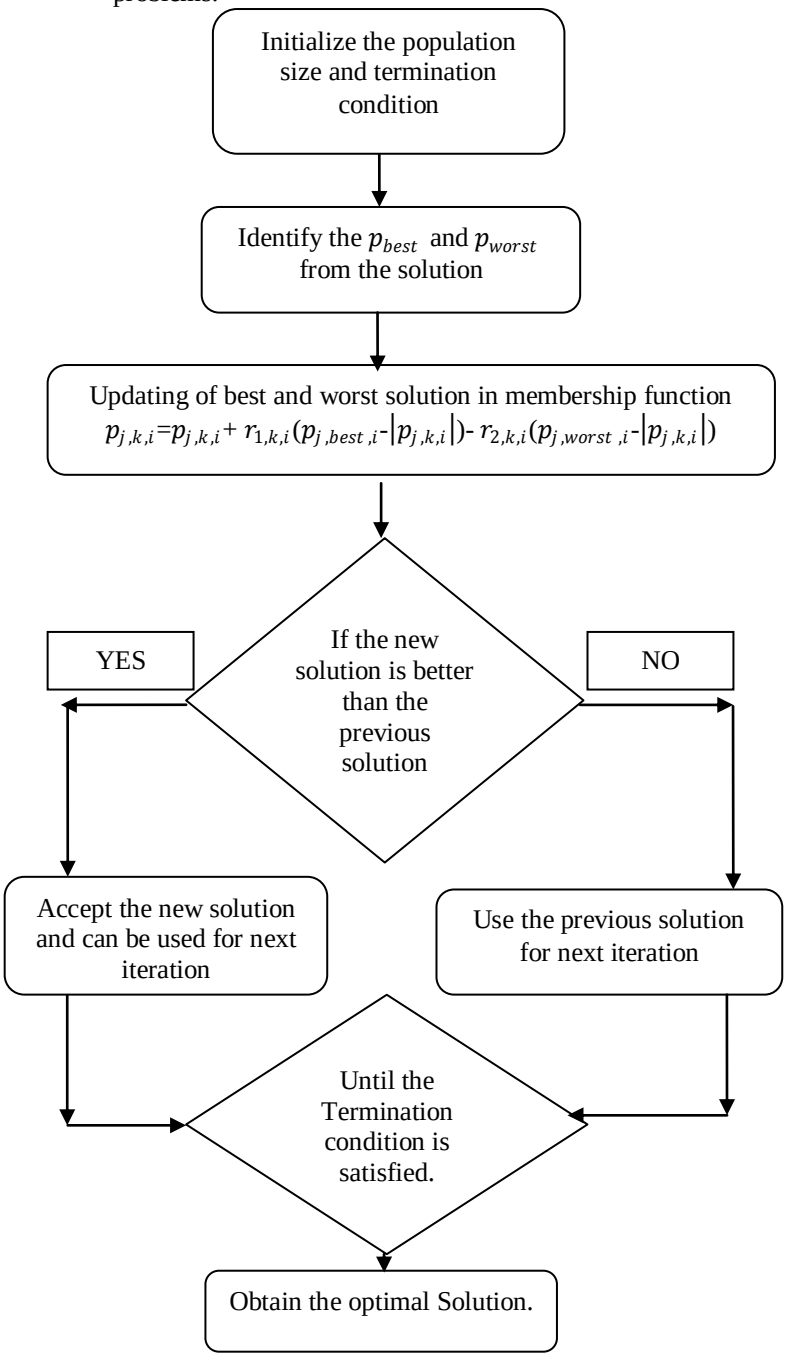


Fig.1: flowchart of Jaya based clustering techniques

Step 1: Initialize the population size and termination condition

First step size of the population is initialized and stopping condition for the process is set for clustering. The initial populations (p) have been created by using the parameters.

$$P=\begin{bmatrix} p_{1,1} & p_{1,2} & \cdots p_{1,n} \\ p_{2,1} & p_{2,2} & \cdots p_{2,n} \\ p_{m,1} & p_{m,2} & \cdots p_{m,n} \end{bmatrix} \quad (1)$$

The design parameters are indicated as 'n' and the candidate solutions is represented as 'm'.

Step 2: Identify the best and worst solution from candidate solutions

The next step is to identify the best solution for the particular iteration. If the best solution is better than the previous one, the best solution will be updated otherwise the previous solution is considered. Same process is repeated for the worst solution also.

$$P_{k,j}=p_j^{min} + \text{rand}(.)[p_j^{max} - p_j^{min}] \quad (2)$$

Random produced number is indicated as rand (.) in the range of (0,-1). p_j^{max} - represents the upper boundaries. p_j^{min} - represents the lower boundaries. $P_{k,j}$ - represents the membership function.

Step 3: Updation of Candidate solution based on best and worst solution obtained

The candidate solution is calculated by using the following equation. Here i,j,k represents the iteration parameters. $r_{1,k,i}$ and $r_{2,k,i}$ are uniformly distributed random number. The best and worst solution is updated in the candidate equation.

$$p_{j,k,i}=p_{j,k,i}+ r_{1,k,i}(p_{j,best,i}-|p_{j,k,i}|)- r_{2,k,i}(p_{j,worst,i}-|p_{j,k,i}|) \quad (3)$$

Step 4: Until the termination condition is satisfied

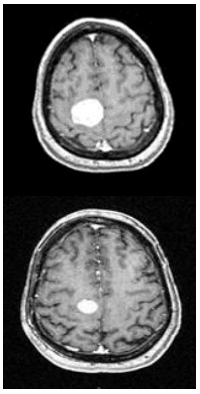
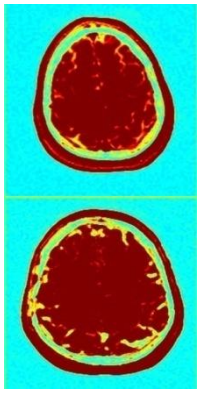
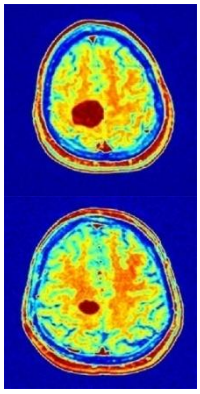
The process of finding the best and worst solution will be continued until stopping condition (based on the fitness function) going to satisfy.

Step 5: Finding the Optimal Solution

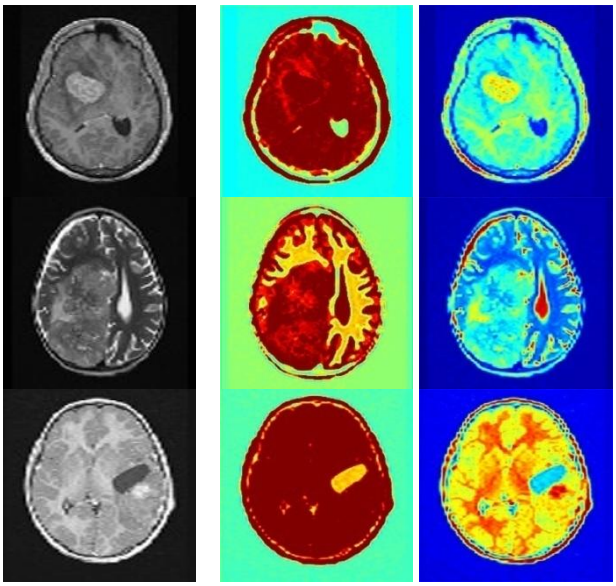
Finally the optimal solution is calculated for the each iteration by repeating the above process.

IV. RESULTS AND DISCUSSIONS

Different type and various grades of tumor are taken for the validation. The jaya perform quite better identifying the tumor and segmenting the other portions compared to the other conventional algorithm.

S. NO	Input Image	PSO Segmentation Results	Jaya Segmentation Results
1			
2			

3



4

5

Table 1: MSE and PSNR Value for JAYA Algorithm

S.No	MSE		PSNR	
	PSO	JAYA Algorithm	FCM	JAYA Algorithm
1	0.1978	0.1672	65.223	55.8985
2	0.5098	0.1896	69.278	55.3532
3	0.7812	0.0951	73.543	58.3498
4	0.7914	0.079	74.108	59.1562
5	0.7918	0.2204	74.123	54.6981

.

A. *Mean square Error (MSE)*

MSE measures the square of error as an average .The variation between the estimated (gray scale input image) and expected output (demarcated image).

$$MSE(Mean\ Square\ Error) = \frac{1}{pq}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[\boldsymbol{X(i,j)} - \boldsymbol{Y(i,j)}]^2 \quad (4)$$

In the above equation the number of rows can be indicated as 'I' and the number of columns can be represented as 'J'. Less MSE values produces better results.

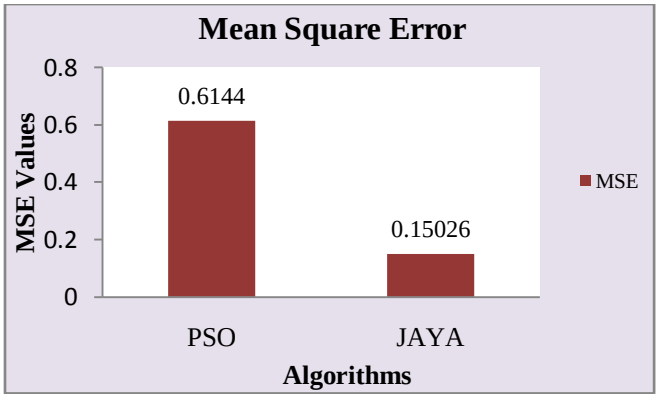


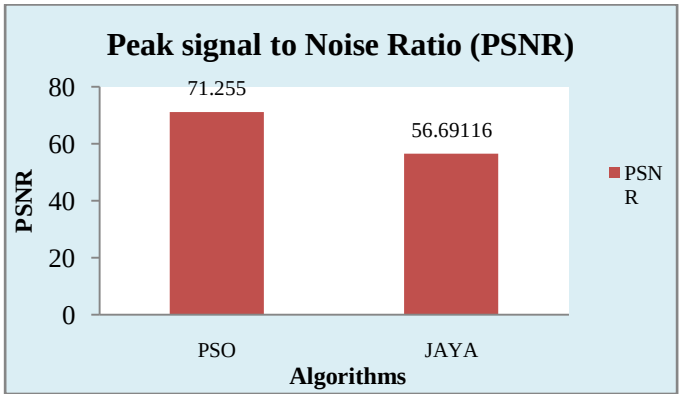
Fig.2.MSE value obtained for JAYA Algorithm

B. *PSNR(Peak signal to Noise ratio)*

PSNR denotes the range lies from the maximum possible value of pixel to influence of undignified noise that incurred the consistency of its slice.

$$PSNR = 10\ log_{10}\left(\frac{MAX_i^2}{MSE}\right) = 20\ log_{10}\left(\frac{MAX_i}{\sqrt{MSE}}\right) = 20\ log_{10}(MAX_i) - 10\ log_{10}\ MSE \quad (5)$$

The segmented algorithm produces less MSE value when compared to the conventional algorithms. The less MSE values leads to produce more PSNR values.



.Fig.3.PSNR value for JAYA algorithm

V. Conclusion

Identifying the various pathologies in medical image is a crucial task. The recommended Jaya algorithm identifies various types of tumors in MRI image and produces better results in terms of segmentation. This technique is compared with the existing technique particle swarm optimization (PSO) and produces better results in terms of MSE and PSNR values and the clustering is done by jaya algorithm by identifying the best and worst solutions and this process are repeated until the similar pixel will be clustered. Finally the optimal solutions are obtained using this techniques and jaya algorithm can be validated in more number of images by identifying different types of pathologies with different grades in future.

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