A SURVEY ON BRAIN IMAGE SEGMENTATION USING PARTICLE SWARM OPTIMIZATION

[1]Komal Vyas, [2]Dr. R. Jegadeesan [3]K. Krishna Chaitanya Rao, [4]Sathvik Thogaru
[1,2,3] UG Student, [2]Associate Professor
[1,3,4] Department of Computer Science and Engineering
[1,2,3,4] Jyothishmathi Institute of Technology and Science, Karimnagar, India

***Abstract* –** Machine learning (ML) has gained enormous application with innovation in hardware requirements for computing. The application of computer vision techniques in health care has one of the aim to reduce human judgment in diagnosis. Thus, human error in judgment may be reduced. One of the primary diagnostic and treatment evaluation tools for interpretation has been magnetic resonance imaging (MRI). In fact MRI characteristics will help the doctor to avoid the human error in manual interpretation of medical content where the smallest aberrances in the human body can be identified. More preferred contrast information about brain tissues is provided by Magnetic Resonance imaging (MRI). MR images can also be used to determine normal and abnormal types of brain. Brain related diagnosis demands at most care and a minute error in judgment may be disastrous. This makes medical imaging very important field. Various imaging methods like CT Scans, X-Ray, and MRI are available but MRI is the most reliable and safe. In fact medical image segmentation is a complex and challenging task due to the intrinsic nature of the images which involves separating the tumor and organisms out of the medical data. Brain tumor segmentation from Magnetic Resonance Imaging (MRI) scans has an important role in the early tumor diagnosis and radiotherapy planning. In the proposed paper we evaluate using Particle Swam Optimization algorithm of medical image segmentation.

***Index Terms* – MRI, Image Segmentation, Particle Swarm Optimization, Principal component Analysis.**

I. INTRODUCTION

The abnormal growth of the tissues is known as the tumor. It is an abnormal mass of tissues that grow and subconsciously multiply cells. Brain tumors can be of any kind, such as primary, diffuse, malignant or benign. In the previous days, PSO can be used to perform simple and extended function for real-time applications such as medical image processing applications, industrial applications, satellite image processing and others. PSO is based on the concept of intelligence squadron. Partitioning is the process of dividing the image into regions with similar properties such as grayscale, color, brightness, and contrast. There are a variety of ways available for segmentation.

Many algorithms have been developed to improve them, such as simulation simulation algorithms, genetic algorithms, ant colony improvement algorithms, and particle optimization algorithms. Swarm Intelligence is an artificial intelligence technology focused on studying the collective behavior of a simple agent system. These factors interact with each other locally and with the environment, leading to the emergence of global patterns. There are many similar types of systems in nature, for example, honey bees, bacteria and animal grazing. Two models of the Enemy Intelligence, Ant Colony Optimization and Optimal Optimization, have already been successfully applied to solve optimization problems in pattern classification and image analysis.

The PSO technique described by Kennedy and Eberhardt, particle swarm algorithms mimics the social behavior of insects. People interact with each other as they learn from their own experience, gradually moving from the population to better areas of the problem. In a PSO system, particles fly in a multidimensional search space. During the journey, each particle adjusts its location according to its own experience and according to the adjacent particle experiment, taking advantage of the best position it and its neighbor face.

II. LITERATURE REVIEW

Bond Marzena & Khalid Saeed [1] explained about automatic detecting system as well as identifying accurate location of tumor by using MRI images.In this process he obtained two algorithms that is image processing and the other one is image segmentation. Through this image processing obtained the highest effectiveness of the algorithm. Important phases are classified into contrast enhancement, Wiener filtering and skull stripping , the main intention behind this technique is to mark label boxes according the type of the tissue that it belongs to white matter,Grey matter and brain tumor. The overall performance of this algorithm is reliable while dealing with various brain images.

Varuna Shree, N. & Kumar, T.N.R. explained about how the medical images will consume time & tedious and also it is not that easy to identify the abnormal structures of the human brain using simple imaging techniques [2]. Also focused on the approaches of removal of noise in the images. A potential neural network matrix was used to train and test the accuracy of performance in tumor site detection in MRI images of the brain. The experimental results achieved a nearly 100% accuracy in the identification of natural and abnormal tissues from MR images demonstrating the effectiveness of the proposed technique.

Brain tumor segmentation from Magnetic Resonance Imaging (MRI) scans have an important role in the early tumor diagnosis and radiotherapy planning. However, MRI images of the brain contain complex characteristics, such as high diversity in tumor appearance and ambiguous tumor boundaries, even when using multi-sequence MRI images[4].

A robust fully automatic method for segmenting the brain from head magnetic resonance (MR) images has been developed by M. S. Atkins and B. T. Mackiewich [3], which works even in the presence of radio frequency (RF) in homogeneities. It has been successful in segmenting the brain in every slice from head images acquired from several different MRI scanners, using different-resolution images and different echo sequences. The method uses an integrated approach which employs image processing techniques based on anisotropic filters and "snakes" contouring techniques, and a priori knowledge, which is used to remove the eyes, which are tricky to remove based on image intensity alone. It is a multistage process, involving first removal of the background noise leaving a head mask, then finding a rough outline of the brain, then refinement of the rough brain outline to a final mask.

SVM is a pattern recognition algorithm which learns to assign labels to objects through examples. N. Abdullah et. al.[5] attempt to use SVM to automatically classify brain MRI images under two categories, either normal or abnormal. The determination of normal and abnormal brain image is based on symmetry which is exhibited in the axial and coronal images. Using feature vector gained from the MRI images, SVM classifiers are use to classify the images. The process consists of two components which are training phase and a testing phase. Percentage of accuracy on each parameter in SVM will give the idea to choose the best one to be used in further works. Other than that, the value percentage will give the first interpretation either the brain image has the possibility of brain tumor or normal.

In this research, a new method was proposed for splitting images based on improved Particle Swarm optimisation (PSO).The traditional method for dividing magnetic resonance imaging (MRI) images is the fuzzy c-means algorithm (FCM)[6].The functionality of this traditional algorithm is sensitive to the spectator and does not integrate spatial information into the image. The algorithm is highly sensitive to noise and homogeneity in the image, moreover, depends on the configuration of the cluster centers initialization. To improve the heavy rejection and to reduce the noise sensitivity of the traditional FCM algorithm, a new FCM extension algorithm is introduced for image segmentation. In general, in the FCM algorithm, the initial mass centers are selected randomly, with the help of the PSO algorithm, the concentration centers are selected optimally. The algorithm also takes into account spatial information. These are used prima facie in cost function to be optimized. For MR images, the resulting opaque assembly is used to set the initial level contour adjustment. The results confirm the effectiveness of the proposed algorithm.

The new method of aggregation of magnetic resonance imaging (MRI) images. At the moment, when aggregation is applied to fragmentation of the brain image, There are two major problems that need to be solved: (i) sensitivity to noise and irregularity (INU). (ii) falling into local minimums and relying on primary focus groups. For the purpose of obtaining a convincing partition performance and addressing the above problems, an effective method is developed within the scope. First, a new objective function was designed using the confluence of the universe with local spatial information and correction of bias , then propose a new algorithm based on improved Particle Swarm optimization (PSO) with the new fitness function to better divide the brain images of MRI. To test its performance, the proposed algorithm was evaluated on several standard images including MRI brain images [7].

Partitioning is the method used to extract the selected area of the image. Now a days Fragmentation is used mainly in medical image processing to detect the affected area. The tumor cannot be controlled growth of abnormal cells in the human brain. Then disaggregates brain tumors based on Particle swarm optimization (PSO) [8]. Particle swarm Optimization is computing-based optimization where the method that is used to improve the problems solution. PSO mainly depends on Objective function and adjust or update the parameters Such as position and speed. The image is made of MRI antiques for films such as patient name and medical. Pre-treatment is a technique which removes unwanted information (noise, film artifacts In MRI) which are present in the original MRI image.

Image splitting is one of the basic techniques in image processing. During the past few years, image processing mechanisms are widely used in various medical fields to detect the early stage, Separation and Disease Identification. In this, time consumption is an important criterion for disease detection of the patient. This research analyzes the discovery and separation of the brain Tumor through magnetic resonance imaging (MRI) images using an particle swarm optimisation(PSO), guided Global optimization method based on intelligence swarm. The algorithm is widely used and developed quickly for ease Implementation. Here mainly four stages including conversion, implementation, selection and extraction. the findings: Research begins with the conversion of digital imaging and communications in medicine (DICOM) to an image file in first stage. Applying the PSO algorithm with the change in n (fragmentation level) values the second phase. Based on time, the best selection of resulting images is the third stage. The final stage is extraction the area affected by the tumor .Research work takes the axial and coronal plane Magnetic resonance imaging (MRI) images. Finally, this work ends with extracting the resulting image, which is captured as input, using the best filtration technique, the affected area can easily be separated and identified efficiently [9].

III. METHODOLOGY

3.1 FLOW CHART DEPICTING THE GENERAL PSO ALGORITHM

At first random position and velocity vectors of the particles are initialized and after that fitness (p) is evaluated for each particles position. If fitness (p) is better than fitness pBest then pBest = p and this process continues until all the particles are exhausted. Set the best of pBest as gBest

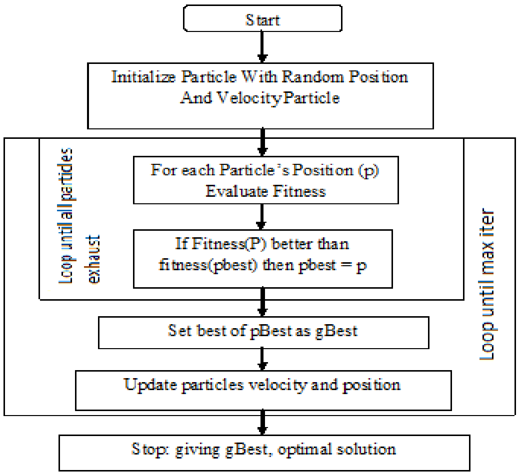


Figure 3.1: Flow chart for PSO algorithm

and update the particle velocity and position until the maximum iteration number. Finally, the optimal solution gBest is given.

3.2 PSO ALGORITHM

It uses variety of agents (particles) that represent a swarm traveling within the search house trying to find the simplest resolution. every particle is treated as some extent in an exceedingly N-dimensional house that adjusts its "flying" in keeping with position and rate. The movement of all particles is influenced by their better-defined original position, and targets the most basic positions known in the search area, which are updated whenever higher positions are found by alternative particles. This can be expected to maneuver the swarm towards simpler solutions Makes little or no assumptions about the issue that is being improved and may be looking at incredibly huge areas of candidate solutions. In addition, PSO does not use the inclusion of the issue that is improved, indicating that the PSO does not need to have the defect of improvement recognizable as required by classical optimization methods such as gradient ratios and similar Newton methods. PSO will thus even be used on improvement issues that are part irregular, noisy, amendment over time, etc..

Consider a swarm of p particles or birds. For particle i, originally proposed that the position xi is adjusted by a stochastic velocity vi which depends on the distance that the particles are from its own best solution and that of its neighborhood. The position xi is updated in the following manner:

$$X_{k+1}^{i} = X_{k}^{i} + V_{k+1}^{i} \quad (3.1)$$

Where velocity vi(k) is calculated as follows:

$$v_{k+1}^{i} = v_{k}^{i} + c_1 r_1 (p_k^i - X_k^i) + c_2 r_2 (p_k^g - X_k^i) \quad (3.2)$$

s is the total number of particles in the swarm,
n is the dimension of problems, i.e., the number of parameters of function being optimized,
c1 and c2 are acceleration coefficients,
r1(k), r2 ~ U(0, 1) representing uniform random numbers,
Xi(k) is the position of particle i at time k,
vi(k) is the velocity of particle i at time k,
pi(k) is the personal best solution of particle i at time k, and
pg(k) is the best position found by the neighborhood of particle i at time k.
From (1), the velocity of a particle is determined by three factors:
1) vi(k) serves as a momentum term to prevent excessive oscillations in search direction,
2) $c_1 r_1 (p_k^i - X_k^i)$ Referred as the cognitive component, which represents the distance that a particle is from the best solution, pi k, found by itself. The cognitive component represents the natural tendency of individuals to return to the environments where they experienced their best Performance, and
3) Referred as the social component, which represents the distance that a particle is from the best position found by its neighborhood. It represents the tendency of individuals to follow the success of other individuals.

3.3 PSO PROCEDURE

1. Create a set of particles with random positions and speeds on a problem area of d dimensions.
2.For each particle, evaluate the optimal fitness function of the d variables.
3. Compare the particle fitness assessment with the value of the best personal particle (pbest). If the value of the current fit function is better than the pbest, set the pbest value equal to the current value, and pbest is equal to the current location in the d-space.

4. Compare fitness assessment with the best previous population value. If the current value is better than the best global value (gbest), set gbest to the value of the current particle and select the best global position vg on the current particle position.
5. Change the velocity and position of particles according to equations (1) and (2), respectively. When w is the weight of inertia, c1 and c2 are the acceleration constants, r1 (t) and r2 (t) are random numbers created in the range between 0 and 1. Speed updates are installed to prevent them from exploding, before it's time. The values of these parameters used in this paper are presented later in the Experimental Results and Discussion Section.
6. Loop to Step 2 until a termination criterion is met. The criterion is usually a sufficiently good fitness or a maximum number of iterations. In this paper, a maximum number of iterations are used [19].

IV. RESULTS AND DISCUSSION

Our following research work focused on the how the brain image segmentation can be carried out effectively, In order to detect the tumor for this we have followed a specific approach called Particle Swarm Optimisation technique and identified the Peak Signal Noise Ratio (PSNR) and Mean Square Error (MSR), The more the PSNR value the good quality of the image is obtained.

Image no\ clusters(k)	k=5	L=k=6	k=7	k=9	k=10	k=11	k=12	k=13	k=14	k=15
1	28.7443	29.0538	29.3296	29.7098	30.1308	31.2361	31.2216	31.2612	32.666	32.8213
2	28.4198	28.4097	28.7443	29.0538	29.3296	29.7098	30.1308	31.1213	31.2612	32.666
3	27.5694	27.6549	28.7423	28.7321	29.8861	29.9891	29.9899	30.3245	31.6543	31.7845
4	28.4589	28.5486	28.7653	29.9865	31.5235	31.6542	32.9846	33.0926	32.5123	32.7468
5	26.6482	26.9617	27.8264	27.9864	28.4098	28.4198	28.3126	29.1567	29.3576	30.6459
6	29.9807	29.7023	29.9826	30.1576	30.3486	31.1258	31.3468	31.4568	31.8657	32.9866
7	26.9866	27.1028	27.1584	28.3474	28.2429	28.2583	29.3654	29.4687	30.1248	30.2486
8	29.3467	29.9864	30.9846	31.9876	32.1257	32.0091	32.0009	31.5682	31.4568	30.2546
9	27.9515	28.544	28.9921	28.8257	28.9248	28.9515	28.9931	30.9866	31.5397	32.1056
10	28.1234	28.2211	28.3267	29.8567	29.9898	32.2971	33.3456	34.2921	34.1122	34.6548

The following table explains about the various clusters and their PSNR Values , In this research we also considered which cluster posses high PSNR and which cluster posses low PSNR values.By this tabular information we can observe how the values are changing based upon the cluster value.

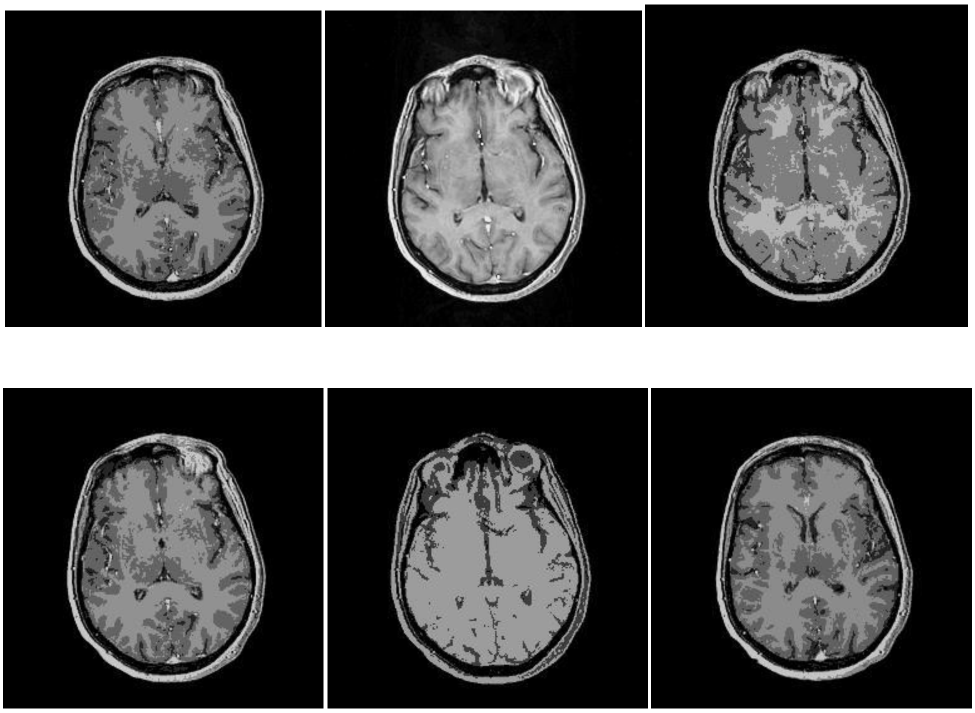
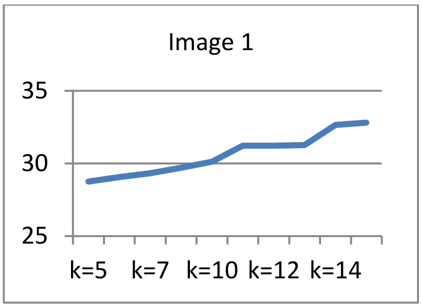
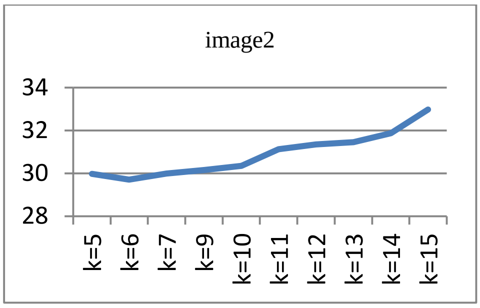
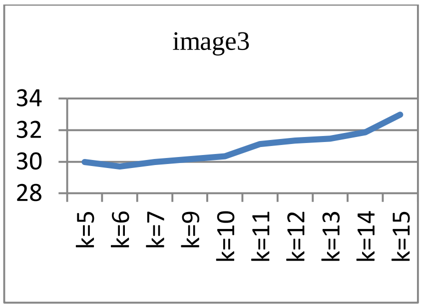
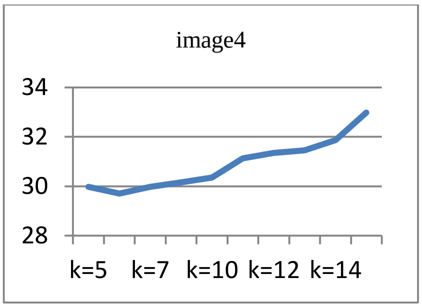


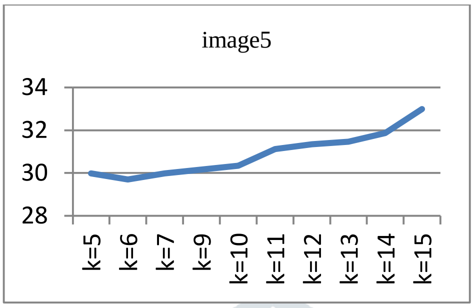
Fig: MRI images of brain after segmentation

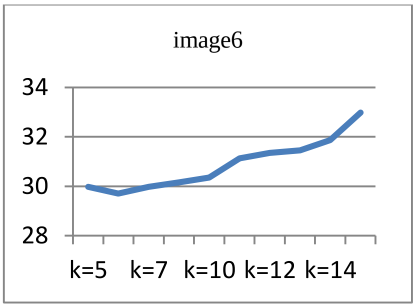












here k represents cluster on x axis and PSNR value is represented on the Y axis, as the cluster size increases PSNR value are changing, the high PSNR indicates image is segmented correctly.

V. CONCLUSIONS

In this proposed work for the brain tumor detection system, we are MRI acquired brain image to perform a series of Processes and improve image quality, we have Apply before processing on the image. Then, to divide Tumor area of the MRI image, existing threshold A fragmentation technique is applied. This division The algorithm is able to divide tumors clearly and able to Outline of tumor area. Proposed partition The algorithm was tested with brain images of MRI Human to detect and locate the tumor in the images. And therefore we focused on the Image accuracy based on PSNR Values, and also segment values where the sudden fall in the PSNR Values the process has done based on the clusters.

VI. REFERENCES

[1] Boberek M., Saeed K. (2011) Segmentation of MRI Brain Images for Automatic Detection and Precise Localization of Tumor. In: Choraś R.S. (eds) Image Processing and Communications Challenges 3. Advances in Intelligent and Soft Computing, vol 102. Springer, Berlin, Heidelberg.

[2] Varuna Shree, N. & Kumar, T.N.R. Brain Inf. Identification and classification of brain tumor MRI images with feature extraction using DWT and probabilistic neural network. Springer , Brain informatics March (2018) Volume 5, Issue 1, pp 23-30. https://doi.org/10.1007/s40708-017-0075-5

[3] M. S. Atkins and B. T. Mackiewich, "Fully automatic segmentation of the brain in MRI," in IEEE Transactions on Medical Imaging, vol. 17, no. 1, pp. 98-107, Feb. 1998.

[4] A. Pinto, S. Pereira, H. Dinis, C. A. Silva and D. M. L. D. Rasteiro, "Random decision forests for automatic brain tumor segmentation on multi-modal MRI images," 2015 IEEE 4th Portuguese Meeting on Bioengineering (ENBENG), Porto, 2015, pp. 1-5.

[5] Jegadeesan,R.,T.Karpagam, Dr.N.Sankar Ram , "Defending Wireless Network using Randomized Routing Process" International journal of Emerging Research in management and Technology ISSN: 2278-9359 (Volume-3, Issue-3) . March 2014

[6] N. Abdullah, U. K. Ngah and S. A. Aziz, "Image classification of brain MRI using support vector machine," 2011 IEEE International Conference on Imaging Systems and Techniques, Penang, 2011, pp. 242-247.

[7] "Improved Fuzzy C-Means based Particle Swarm Optimization (PSO) initialization and outlier rejection with level set methods for MR brain image segmentation ",AbdenourMekhmoukh ,KarimMokrani ,Computer Methods and Programs in Biomedicine,Volume 122, Issue 2, November 2015, Pages 266-281.

[8] Jegadeesan,R., Sankar Ram "Defending Wireless Sensor Network using Randomized Routing "International Journal of Advanced Research in Computer Science and Software Engineering Volume 5, Issue 9, September 2015 ISSN: 2277 128X Page | 934-938

[9] "Integrating fuzzy entropy clustering with an improved PSO for MRI brain image segmentation",Thuy XuanPham,PatrickSiarry,HamoucheOulhadj ,Applied Soft Computing,Volume 65, April 2018, Pages 230-242.

[10] Jegadeesan,R., Sankar Ram,N. "Energy-Efficient Wireless Network Communication with Priority Packet Based QoS Scheduling", Asian Journal of Information Technology(AJIT) 15(8): 1396-1404,2016 ISSN: 1682-3915,Medwell Journal,2016

[11] "SEGMENTATION OF BRAIN TUMOR MRI BASED ON PARTICLE SWARM OPTIMIZATION",R.Punidha, 2 S.Sakthivel, 3V.Nehru, 4C.Gunasundari,International Journal of Pure and Applied Mathematics Volume 116 No. 23 2017, 1-7.

[12] "Detection of Brain Tumor by Particle Swarm Optimization using Image Segmentation ",S. Mahalakshmi* and T. Velmurugan ,Indian Journal of Science and Technology, Vol 8(22), DOI: 10.17485/ijst/2015/v8i22/79092 September 2015.