



## Review on: Brain Image Segmentation by Ant Colony Optimization in Brain Tumor Diagnosis

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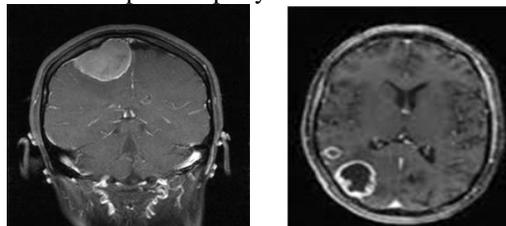
**Abstract:** The segmentation of brain tumor from MR images is efficient but time consuming task performed by Medical experts. Magnetic resonance image segmentation play key role in diagnosis of diseases. MRI (Magnetic Resonance Imaging) segmentation is manually time consuming and complex method in simplification medical cases. Cancer cell growth is different normal cell growth. Instead of dying cancer cells continue to grow and form new, abnormal cells. MRI scan optimizes the soft tissues in human body, where CT (Computer Tomography) Scan is used for observing bone structure. MRI provides detailed information about brain tumor anatomy, cell structure for effective diagnosis, treatment. Malignant brain tumors that were cancerous can spread within the spine of brain. They affect the nearby cells of brain and spine by way of cerebrospinal fluid. Ant Colony Optimization algorithm is a probabilistic technique for solving computational problem inspired by foraging behavior of ants. Ant Colony Optimization and K-means clustering algorithm used for classification of normal and abnormal tissues.

**Keywords:** Magnetic Resonance Imaging (MRI), ACO, Brain Tumor, K-means.

### I. INTRODUCTION

Brain is portion of central nervous system that is located within the skull. It is soft spongy mass of tissue that is protected by bones of skull and three thin membranes called meninges. Brain tumor is group of abnormal cells or indirectly damage healthy cells of brain and causing inflammation, brain swelling and pressure within the skull. Brain tumor are of two types one is benign and other is malign. Generally, brain tumors have various shapes and sizes which are different from one case to another the effect of benign and malign are to some extent alike and can cause similar problems depending on their kind and location. Brain and spinal cord tumors are masses of abnormal cells in the brain that have grown out of control. Benign Tumor do not grow into nearby tissues or spread to distinct areas .so on other parts of body they are almost never life threatening. Malignant tumors are dangerous because they spread to another parts of body. Tumors in critical area of brain cause weakness, stiff muscles or problem with sensation, facial or eye movement. Double vision is a common early symptom of brain stem tumors. Doctors group brain tumors by grade, The grade of tumor refers to way the cells look under microscope [5].

- 1) Grade 1- Benign tissues, these tissues looks like normal tissues slowly risen these cells.
- 2) Grade 2- The cells are malignant these tissues looks like normal tissues like grade 1 tissues.
- 3) Grade 3- These malignant tissues are different from normal cells. These abnormal cells are fast growing.
- 4) Grade 4- These are most abnormal cells and spread rapidly.



Brain tumor is leading cause of cancer in children under the age of 20. Another leading age of brain tumor is 20-29. Medical imaging is one of the most precise tool in medical field for diagnosis and ease of treatment. Medical Resonance Imaging (MRI), Computer Tomography (CT), digital mammography and other imaging techniques are effective ways to find anatomy of internal organs of human body. Now a day's these techniques play key role in medical research, diagnosis and healthy treatment. Since last two decades that computer aided tumor detection on medical images has being studied, MR images are still very difficult to solve. Interpretation of these images is very sensitive and also for reducing the probability of misdiagnosis, multiple radiologists are used to review the images before come to final result [2].

To overcome these difficulties we find a more proper threshold value for brain MR image segmentation, by improving Ant Colony Optimization algorithm. Ant Colony Optimization is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs. It is initially proposed by Marco Dorigo in 1992 in

his thesis inspired by foraging behavior of ant colonies. Individuals ants are simple insects with limited memory and capable of performing simple actions. However, the collective behavior of ants provides intelligent solutions to problems such as finding the shortest paths from the nest to food lay down quantities of a volatile chemical substance named pheromone, making their path that it follows. Ants smell pheromone and decide to follow the path with high quantity of pheromone. The Probability that an ant chooses a path increases with number of ants choosing the path at previous times and with the strength of pheromone concentration.

## **II. LITERATURE REVIEW**

Improved ant colony algorithm was done by improving tendency of ant to move in different direction in probabilistic selection rule. This algorithm shows balance between the ant's direction and distribution of pheromone. The region detected as tumor is more distinct, clear and without any extra margin which is usually caused by inflammation [1]. The swarm intelligence approach for detection of brain tumor segmentation in MRI. It proposed ant colony optimization algorithm is possible to accurately segment the tumor portion from MRI. Swarm algorithm is based on behaviors of different swarm of animals and insects [2]. The algorithm which deals with technique ACO hybrid with fuzzy algorithm has proposed by Dr. M. Karnan in which Ant Colony Optimization. The tumor position and pixel similarity are measured with Radiologist report. Only the pixel having optimum label are extracted from the original brain image to form segmentation image [5]. The merit of improved implementation of brain segmentation using meta heuristic algorithm is that automatic segmentation is detecting the required tumor tissues from brain MRI in two different approaches namely algorithmic and non algorithmic. The automatic segmentation of brain tumor from MRI described a gradient-based brain image segmentation using Ant Colony Optimization and block based technique [6]. Ant Colony Optimization to solve many optimization problems with good discretion, parallel, robustness and positive feedback proposed by Myung-Eun Lee. This algorithm not only give robust segmentation but also segment thin parts more effectively also this algorithm has advantage that effectively segment images [7].

A non-parametric distribution model including all statistical information of different parts of brain is made by simple healthy brain MRI Images and then it will called as optimization of cost function. Based on global rather than pixel wise information, the proposed algorithm does not required a complex learning from a large training set, as is the case in existing methods [8]. Hybrid Markov Random Field with Parallel Ant Colony Optimization and Fuzzy C Means for MRI Brain Image segmentation investigated the most effective optimization method, known as Hybrid Parallel Ant Colony Optimization, new CAD system is developed for verification and comparison of brain tumor detection algorithm. This algorithm determines optimal threshold value by selecting initial cluster points the results are compared with existing approaches and find result faster than others [9]. Ant Colony Optimization is introduced for resolving for edge detection in biomedical images. Proposed method, uses artificial neural network with supervised learning along with momentum to improve edge detection based on ACO the proposed method compared with Jing Tian method and finds higher speed less processing time the experimental result shows that make use to improve edge detection based on ACO the proposed method compared with Jing Tian method and finds higher speed less processing time the experimental result shows that make use neural network are very effective in edge detection based on ACO [10].

## **III. SEGMENTATION**

Segmentation plays key role in diagnosis of medical images. It is used in detection of tumors, measuring tumor volume, in digital mammograms. For exact guideline of medical of medical treatment Magnetic Resonance Imaging divide the image into sub region we want. That's why easy diagnosis of small tissues, complex organs diseases is possible. Human brain consists of various layers. A MR images exactly divide these layers and gives individual result. Gray matter, cerebrospinal fluid, cerebellum, brain stems etc. individually describe by MR images which easier the medical efforts of doctors [11]. Lots of algorithms have been proposed in few years. Some of the popular methods are included thresholding, clustering, edge detection. Thresholding is very simple and efficient. The best method next to the thresholding for MR image segmentation is clustering. Fuzzy C-clustering, k-means clustering are probably used for better segmentation [12]. Clustering is a process for classifying objects or pattern in such a way that samples of the more similar to another than samples belonging to different clusters. Fuzzy c-means clustering gives excellent diagnosis of normal brains but it fails the exact location of tumor and its influence on neighboring tissues.

## **IV. SEGMENTATION BY ANT COLONY OPTIMIZATION**

Dorigo and Ganbarde proposed an Ant colony optimization algorithm Travelling salesperson problem push for necessity of proposing new algorithm. The study finds the result ants are social insects which lives in colonies rather than surviving individuals. Key characteristic of ants is their behavior of finding their food. Shortest path between food source and their nest tries to find by ants. Ant colony algorithm propose a random behavior of ants are distinct from each other. Ant deposit a special chemical substance known as pheromone on their path to find food. Deposition of pheromone on their path and food quality, other ants smells the pheromone and is attracted by this path and also increase quantity of pheromone on repeated path. Ant's movement depends upon simple instinctive behavior. They choose the path which has more pheromone. Evaporation of pheromone is done even through it remains as ants trace for short time. As more time spends more pheromone evaporates and probability of choosing certain path evaporates [1].

Ants foraging for food follows the quality of volatile chemical substance that is pheromone and decide to follow the path with high probability and their by reinforce it with a further quantity of pheromone. The probability that an ant choose a path increases with the number of ants choosing the path increases with number of ants choosing the path at

previous time and with the strength of pheromone concentration [1]. In order to solve the problem, ant k uses probabilistic selection rule to choose a path, probability of k<sup>th</sup> ant movement from I to j can be calculated by equation.

$$P_{ij}^k = \frac{[\tau_{ij}]^\alpha [n_{ij}]^\beta}{\sum_{l \in N_i^k} [\tau_{il}]^\alpha [n_{il}]^\beta}, \text{ if } j \in N_i^k$$

Where  $\tau_{ij}$  is the amount of deposited pheromone between nodes  $i$  and  $j$  and also  $N_i^k$  is neighborhood nodes for ant  $k$  in the node  $i$ . Constants  $\alpha$  and  $\beta$  will control the influence of pheromone and heuristic function. After completing the path, the pheromone amount on the path will be updated by

$$T_{new} = (1-e) * T_{old} + e * T_0$$

Where  $T_{old}$  and  $T_{new}$  are the old and new pheromone values and  $e$  is rate of pheromone evaporation parameter in local update ranges from [0, 1] i.e.,  $0 < e < 1$  [3].

## V. K-MEANS CLUSTERING

Clustering is a process for classifying objects or patterns in such a way that samples are more similar to one another. K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume  $k$  clusters) fixed a priori. The main idea is to define  $k$  centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early groupage is done. At this point we need to re-calculate  $k$  new centroids as barycenters of the clusters resulting from the previous step. After we have these  $k$  new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the  $k$  centroids change their location step by step until no more changes are done. In other words centroids do not move any more. By normalizing pheromone matrix and primary image got the binary image. Then k-means clustering is applied to binary image which creates final segmented image.

The algorithm consist of following steps.

1. Place  $K$  points into the space represented by the objects that are being clustered. These points represent initial group centroids.
2. Assign each object to the group that has the closest centroid.
3. When all objects have been assigned, recalculate the positions of the  $K$  centroids.
4. Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.

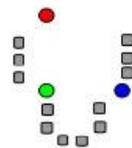


Figure 1 Initialization of K-Means

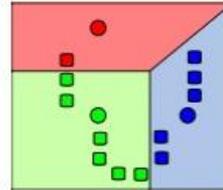


Figure 2 Generation of K clusters.

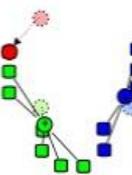


Figure 3 Generation of new K-mean.

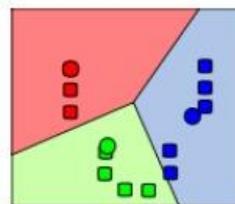


Figure 4 Convergence of the clusters.

## VI. CONCLUSION

Brain image segmentation is complex and challenging part in medical image processing thus it requires more automated and efficient algorithm for more accurate clinical implementation. Ant colony algorithm is heuristic method for solving critical problems in brain tumor segmentation, more proper threshold value for brain MR image segmentation is done by improving ant colony optimization algorithm. Collective behavior of ants provides intelligent solution to problems such as shortest path finding. Lots of algorithms proposed with ACO but k-means clustering with ACO gives more fine result and less computation time.

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