ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

Intelligent Based Brain Tumor Detection Using ACO

Punithavathy Mohan*,Vallikannu. AL*, B.R.Shyamala Devi*, B.C.Kavitha*

*Assistant Professors, Department of Electronics and Communication, Hindustan Institute of Technology and Science, Chennai, India

ABSTRACT: Cancer is the uncontrolled growth of abnormal cells in the body. It can develop in almost any organ or tissue, such as the lung, colon, breast, skin, bones, or nerve tissue. Among these, brain cancer is one of the most threatening diseases and leading cause of cancer death in young people. Once diagnosed, patients have just a five percent chance of surviving this extremely aggressive disease. Hence detecting the brain tumor in early stage is very essential to improve the survival rate. Segmentation is an important aspect in medical image processing where, identification of abnormalities in brain is difficult. MRI (Magnetic Resonance Imaging) Scan analyses the soft tissues in human body, whereas CT (Computed Tomography) Scan is used for observing bone structures. MRI provides detailed information about brain tumor anatomy, cell structure and vascular supply, making it an important tool for the effective diagnosis, treatment and monitoring of the disease. This paper deals with Enhancement, Segmentation, Extraction and Classification of the MR Brain Image. The algorithm proposed here is CLAHE algorithm, Ant Colony Optimization (ACO) and K-means algorithm. ACO is used for segmentation of the image and K-means algorithm is used for classification of normal and abnormal tissues in the MR brain image with accuracy and reduced time complexity.

Keywords: Magnetic Resonance Imaging(MRI), CT- Scan, K-Means, ACO, CLAHE algorithm, Brain Tumor.

I. Introduction

Brain cancer is a tumor or cancerous growth in the brain. A tumor, whether in brain or elsewhere, is a mass of cells that reproduce themselves in an uncontrolled way. There are two main types of brain tumor. Brain cancer that originates in the brain is called a primary brain tumor. It can spread and destroy nearby parts of the brain. Cancers of the breast, lung, skin, or blood cells (leukemia or lymphoma) can also spread (metastasize) to the brain, causing metastatic brain cancer. Brain tumors can be benign, with no cancer cells, or malignant, with cancer cells that grow quickly.Benign brain tumors are abnormal collections of cells that reproduce slowly and usually remain separate from the surrounding normal brain.They grow slowly, do not spread to other parts of the brain and can usually be removed more easily than malignant tumors. Malignant tumors grow and spread aggressively, overpowering healthy cells by taking their space, blood, and nutrients. Like all cells of the body, tumor cells need blood and nutrients to survive.Their borders are hard to distinguish from the normal brain around them. That is why it is hard to remove them completely without damaging the surrounding brain.

Tumors may or may not be symptomatic: some tumors are discovered because the patient has symptoms, others show up incidentally on an imaging scan. Identifying the presence of a brain tumor is the first step in determining a course of treatment.In case of brainimages, MRI scan is preferred than CT scan, the reason is as follows:

A. CT Scan

A CT scan combines sophisticated x-ray and computer technology. CT can show a combination of soft tissue, bone, and blood vessels. CT images can determine some types of tumors, as well as help detect swelling, bleeding, and bone and tissue calcification. Usually, iodine is the contrast agent used during a CT scan.

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

B. MRI Scan

MRIis a scanning device that uses magnetic fields and computers to capture images of the brain on film. It does not use x-rays. It provides pictures from various planes, which permit doctors to create a three-dimensional image of the tumor. The MRI detects signals emitted from normal and abnormal tissue, providing clear images of most tumors.

An MRI is performed in a similar way to a CT scan - the patient usually enters a cylindrical machine. However, an MRI scan tends to last longer, and can last up to 45 minutes. In some cases, the patient will be injected with a dye, helping the technician to make the image even clearer.MRI scans are far superior for collecting images for areas of the body apart from bone. They are also more versatile, and are used for help in diagnosing a wide variety of conditions.Another benefit to an MRI scan is that it does not expose either patient or technician to potentially harmful radiation. Although the length of time of exposure is relatively short, CT scans still have this risk; there are no known adverse effects to the patient from an MRI scan.

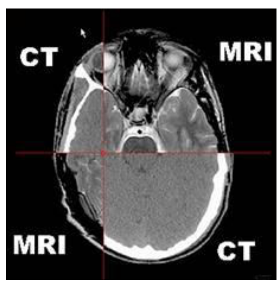

Figure 1.1An image showing the difference betweenCT scanned image and MRI scanned image.

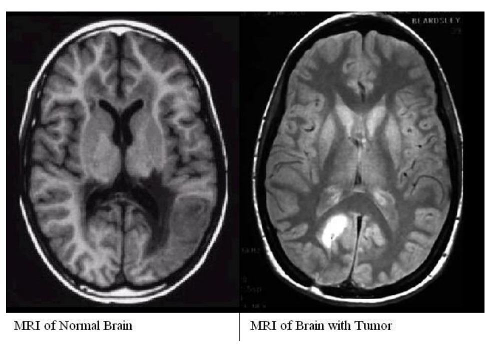

Figure 1.2Comparison of MR Brain Images with and without tumor.

II. LITERATURE SURVEY

Literature pertaining to detect brain tumor in MR Image of brain using K-Mean, CLAHE algorithm and ACO are presented. J. Selva Kumar, et al. proposed computer aided method for segmentation of tumor based on the combination of two algorithms [1]. The stage of tumor is displayed based upon the amount of area calculated from the cluster. P. Vasuda, S.Satheesh used improved fuzzy k means algorithm for MR brain image segmentation [3]. Emdaldin,et al. made use of hybrid image segmentation technique [5].

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

This paper deals with Enhancement, Segmentation, Extraction and Classification of the MR Brain Image. Enhancement is done by using CLAHE algorithm which is succession of Adaptive Histogram Equalization. ACO is used for segmentation and K-means algorithm for classification of normal and abnormal tissues in the MR brain image. The use of ACO algorithm yields an efficient and accurate output with reduced timecomplexity.

III. EXISTING SYSTEMS

Table 1 Comparison of existing methods

S.No.	Methods/Algorithms	Drawbacks
1.	Watershed transform	Over Segmentationdue to absence ofWatershedlines (dams).
2.	Level Set method	High computational cost.
3.	Thresholding	Thresholding has only binary values 0 and 1. But when a Bitmap Image is considered, some tumor cells can be ignored.
4.	Region Growing	More user interactionis required to select the ‘seed’.
5.	Fuzzy C-mean	i) High Computational time. ii) Low Computational rate.
6.	Artificial Neural Network	Larger training set is required.

IV. PROPOSED SYSTEM

The block diagram for the proposed method is shown in Figure 4.1. Enhancement is done using CLAHE (Contrast Limited Adaptive Histogram Equalization) algorithm. Segmentation, Extraction & Classification is done using (ACO) Ant Colony Optimizationcombined with K-Means algorithm. Noise removal is achieved in the first level of image enhancement via CLAHE algorithm. Basically, ACO algorithm is used for segmentation of any image in a more accurate manner in less time and K-means is used in classification of normal and abnormal tissues in the MR brain image. So, the MR brain tumor image is trained in the K-means algorithm and then combined with the ACO algorithm for the segmentation process.

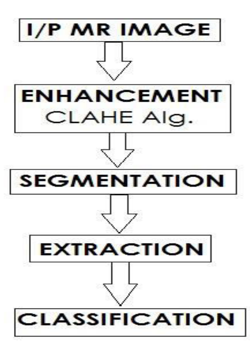

Figure 4.1 Block Diagram

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

A.Image Enhancement Using CLAHE Algorithm

CLAHE(Contrast Limited Adaptive Histogram Equalization)is an improved version of AHE (Adaptive Histogram Equalization). Both overcome the limitations of standard histogram equalization.CLAHE differs from ordinary adaptive histogram equalization in its contrast limiting. Sharp field edges can be maintained by selective enhancement within the field boundaries. Selective enhancement is accomplished by first detecting the field edge in a portal image and then only processing those regions of the image that lie inside the field edge.

B. Image Segmentation Using ACO Algorithm

ACO is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs.Initially proposed by Marco Dorigo in 1992 in his PhD thesis, the first algorithm was aiming to search for an optimal path in a graph, based on the behavior of ants seeking a path between their colony and a source of food. The original idea has since diversified to solve a wider class of numerical problems, and as a result, several problems have emerged, drawing on various aspects of the behavior of ants.

In a series of experiments on a colony of ants with a choice between two unequal length paths leading to a source of food, biologists have observed that ants tended to use the shortest route.A model explaining this behavior is as follows:

1. An ant (called "blitz") runs more or less at random around the colony
2. If it discovers a food source, it returns more or less directly to the nest, leaving in its path a trail of pheromone
3. These pheromones are attractive; nearby ants will be inclined to follow, more or less directly, the track returning to the colony, these ants will strengthen the route
4. If there are two routes to reach the same food source then, in a given amount of time, the shorter one will be traveled by more ants than the long route
5. The short route will be increasingly enhanced, and therefore become more attractive
6. The long route will eventually disappear because pheromones are volatile;
7. Eventually, all the ants have determined and therefore "chosen" the shortest route.

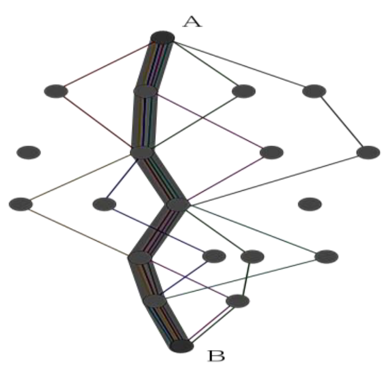

Figure 4.2 Ants selecting the shortest path from A to B and vice versa.

The basic philosophy of the algorithm involves the movement of a colony of ants through the different states of the problem influenced by two local decision policies, viz., trails and attractiveness. Thereby, each such ant incrementally constructs a solution to the problem. When an ant completes a solution, during the construction phase, the ant evaluates the solution and modifies the trail value on the components used in its solution. This pheromone information will direct the search of the future ants. Furthermore, the algorithm also includes two more mechanisms, viz., trail evaporation and

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

daemon actions. Trail evaporation reduces all trail values over time thereby avoiding any possibilities of getting stuck in local optima. The daemon actions are used to bias the search process from a non-local perspective.

C. Classification Using K-Means Algorithm

The K-Means is a simple clustering algorithm used to divide a set of objects, based on their attributes/features, into k clusters, where k is a predefined or user-defined constant. The main idea is to define k centroids, one for each cluster. The centroid of a cluster is formed in such a way that it is closely related (in terms of similarity function) to all objects of that cluster.Since the number of clusters to be formed is predefined, the objects in the input list are initially divided into random groups, that is, each object is assigned to a random cluster. After this, the algorithm iteratively refines each group by moving objects from irrelevant group to relevant group. The relevance is defined by the similarity measure or function. Whenever a new object is added or removed from a cluster, its centroid is updated or recalculated. Each iteration is guaranteed to increase the similarity between all the points inside a cluster. This iterative refinement is continued until all the clusters become stable i.e. there is no further movement of objects between clusters. The k-means algorithm is also referred to as Lloyd's algorithm.

D.Demonstration of K-Mean Algorithm

Steps followed in k-means algorithm are:

1) k initial "means" (in this case k=3) are randomly generated within the data domain (shown in color).
2) k clusters are created by associating every observation with the nearest mean. The partitions here represent the Voronoi diagram generated by the means.
3) The centroid of each of the k clusters becomes the new mean.
4) Steps 2 and 3 are repeated until convergence has been reached

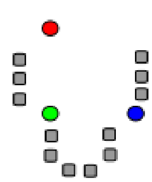

Figure 4.3 Initialization of K-Means

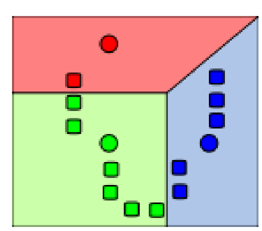

Figure 4.4 Generation of K clusters.

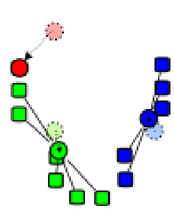

Figure 4.5 Generation of new K- mean.

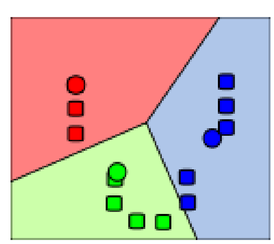

Figure 4.6 Convergence of the clusters.

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

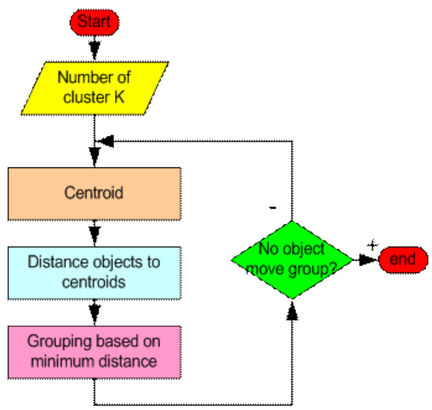

Figure 4.7 Flowchart of K-mean algorithm

V. SOFTWARE USED

A. MATLAB

The MATLAB version used here is Matlab 7.6.0(R2008a). MATLAB is used for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing. Image Processing Toolbox provides a comprehensive set of reference-standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development. We can perform image enhancement, image de-blurring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration.

Image Processing Toolbox supports a diverse set of image types, including high dynamic range, gigapixel resolution, embedded ICC profile, and tomographic. Graphical tools allow us to explore an image, examine a region of pixels, adjust the contrast, create contours or histograms, and manipulate regions of interest (ROIs). With toolbox algorithms we can restore degraded images, detect and measure features, analyze shapes and textures, and adjust color balance.

VI. RESULTS

A. Input MR Brain image

The input image is shown in Figure 6.1.

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

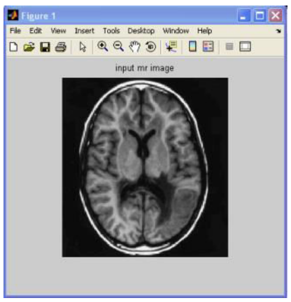

Figure 6.1 Input MR Brain image.

Figure 6.2 Output enhanced image

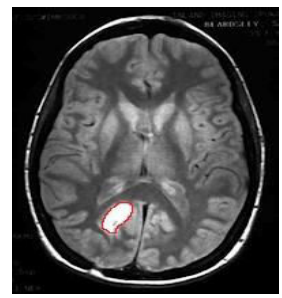

Figure 6.3 Tumor region in brain is highlighted using ACO

B. Output Enhanced MR Brain Image.

The given input MR Image of Brain is enhanced in the initial stage by using CLAHE algorithm.The Enhanced output image is shown in Figure 6.2.

VII. CONCLUSION ANDFUTURE WORK

Thus by using CLAHE algorithm, removal of noise and enhancement is done together. So, using CLAHE algorithm in the first level of implementation, will giveefficient image enhancement, compared to any other enhancement methods. And by using ACO algorithm extraction of tumor from brain MR image is done. Whereasusing K-Means algorithm, the brain tumor image is segmented and trained in with ACO for extraction and classification.Future work can be carried out in the 3D assessment of the brain using 3D slicer.

REFERENCES

1. Sevla Kumar J, Arivoli T, Lakshmi A.“Brain Tumor Segmentation and its Area calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm”. International Conference on Advantages In Engineering, Science and Management. March 2012.
2. M.C. Jobin Christ, R.M.S. Parvathi. “Detection of Brain Tumor using Hybrid Topology Preserving Map”. International Journal of Computer Applications, August 2012.
3. P. Vasuda, S.Satheesh. “Improved Fuzzy C-Means Algorithm for MR Brain Image Segmentation”. International Journal of Computer Science and Engineering, 2010.
4. Lalit P. Bhaiya, SuchitaGoswami. “Classification of MRI Brain Images using Neuro Fuzzy Model”. International Journal of Electronics Communication and Computer Engineering, 2012.
5. EmadaldinMozafariMajd, M.A. As’ari, U.U. Sheik, S.A.R. Abu-Bakar. “Hybrid Image Segmentation using Fuzzy C-Means and Gravitational Search Algorithm”.Fourth International Conference on Digital Image Processing, 2012.
6. Caroline Pantofaru, Martial Hebert. “A Comparison of Image Segmentation Algorithm”. TheRobotics Institute, Carnegie Mellon University, September 2005.
7. M.Masroor Ahmed, Dzulkifli Bin Mohamad. “Segmentation of Brain MR Images of tumor extraction by combining K-Means Clustering and Perona-Malik Anisotropic Diffusion Model”. International Journal of Image Processing. Volume 2, 2010.

ISSN (Print): 2320-9798
ISSN(Online): 2320-9801

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 1, Issue 9, November 2013

BIOGRAPHY

Punithavathy Mohan is a Gold Medalist in both B.E and M.E in ECE and Communication Systems from Bharathidasan University and Anna University, Tamilnadu, India in 1992 and 2009 respectively. She has more than 10 years of teaching experience. Currently she is an Assistant Professor in school of Electrical Sciences and working towards her PhD in medical image processing in Hindustan University. She is a member of IEEE Communication society. Her area of interest includes image processing, signal processing, digital communication.

Vallikannu ALreceived her B.Eng. degree in Electronics and Communication Engineering from Institution of Engineers (India), in 1999, M.E degree in AppliedElectronics from Anna University , Chennai, Tamilnadu, India, in 2005, and currently pursuing Ph.D. degree in Adhoc Networks in Hindustan University , Tamilnadu, India.She has more than 13 years of teaching experience. Currently she is an Assistant professor in School of Electrical Sciences at Hindustan University.She is a Life time member of the Institution of Engineers (India); and the Institution of Electronics and Telecommunication Engineers (IETE). Her research interests cover wireless communications, Antennas and wave propagation and Embedded Systems.

B.R Shyamala Devi received the B.E in Electronics and Communication Engineering and M.E in Applied Electronics from Government College of Engineering, Tirunelveli (Tamilnadu), India in 2000 and 2005 respectively. She was a part time Lecturer with Government College of Engineering, Tirunelveli (Tamilnadu), India from 2001 to 2005.She is now an Assistant Professor at Hindustan University, Chennai, India since 2005, where she is pursuing her Ph.D degree in Wireless Sensor networks. Her research interests include medium access and routing in wireless sensor networks, quality of service in WSNs, Wireless communication and Networks. She is a member of IEEE and life member of IETE.

B.C. Kavitha obtained her B.Tech degree in Electronics and Communication Engineering from Cochin University of Science and Technology in the year 2000 and ME degree in Communication Systems from Hindustan College of Engineering, Anna University in 2008. Currently she is associated with Hindustan University as Assistant Professor. She has a total of 10 years teaching experience and her field of interest includes sensor networks and optical communication.