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Study and Literature Survey for Brain Tumor Detection and its Area Measurement using Genetic Algorithm Based on K-Means Clustering

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Abstract*:* The brain is the main processing unit of the central nervous system and its structure is very complicated. Tumor is nothing but an unstoppable growth of tissues in any part of the body. Tumors are of different types and characteristics and also have different treatments. Brain tumor extraction and its analysis are challenging tasks in medical image processing because brain image and its complex structure. Segmentation is applied in medical images is an essential process in analyzing and curing an illness. Thus, it is obvious that the purpose of clustering in medical images is the recognition of damaged areas in tissues. Here a brief review of different segmentation techniques has been discussed for detection of tumor from Magnetic Resonance Imaging (MRI) of brain. Finally we propose an automatic tumor detection system using image segmentation method.

Keywords: MRI ,brain tumor, image segmentation, k- means clustering, Genetic Algorithm.

I. INTRODUCTION

Brain is most important part of central nervous system in body. Brain is symmetric about vertical axis. Functioning and structure of brain is very complicated so it is very challenging task for doctors and radiologists to detect tumor and cure it. Doing this manually is very difficult and time consuming, .researchers develop various techniques for automatic detection of tumor , its location and area.

The tumor is mainly two types: cancerous tumors and benign tumors. Malignant tumor involves abnormal cell growth with the ability to spread to other parts of the body. Benign tumors do not spread to other parts of the body. Figure 1 shows the presence of tumor.

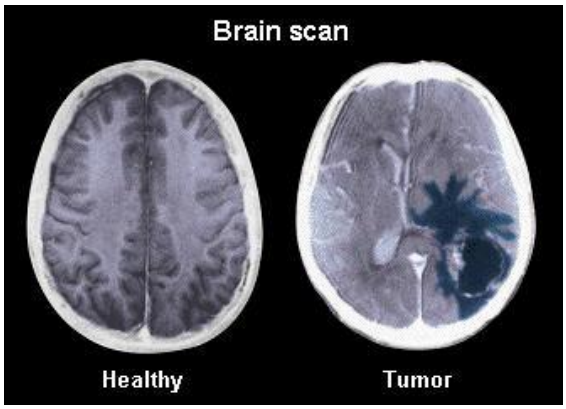

Figure1: original image infected image

Normally brain tumor affects Cerebral Spinal Fluid. It causes strokes. The physician gives the treatment for the strokes rather than the treatment for tumor. Tumor detection is important for treatment. Medical image techniques play an important role in diagnosis and detection of tumor. MRI provides information such as tumor location to radiologists, way to diagnose tumor and cure it easily[5]. the tumor size, location, shape and presence are very different in different patient images as shown in fig.2

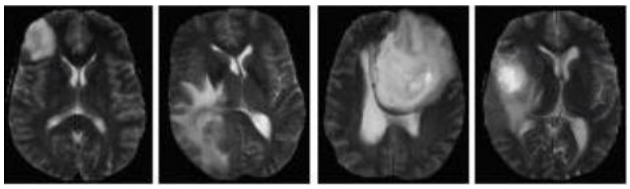

Figure 2. Mri Depicting Tumours In Brain Images Of Different Patients[5]

Below given bar graph witch showing number of persons who have diagnosed from tumor and number of persons who died of tumor[5].

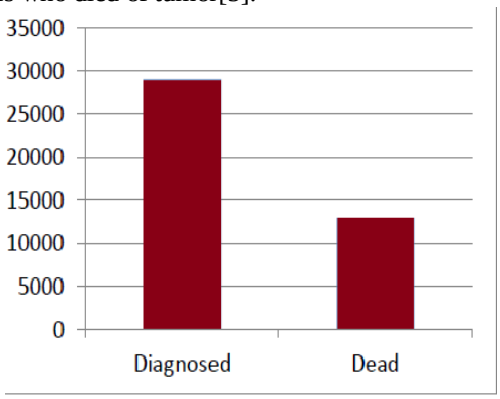

Figure3: analysis of tumor diagnosis[8]

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Image segmentation plays a important role in image processing as it helps in the extraction of suspicious regions from the medical images[9]. The mechanization of medical image segmentation has established wide application in diverse areas such as treatment management planning, and computer-integrated surgery[13].

II.LITERATURE REVIEW

In [3], author uses K-Means algorithm to implement the Identification of the MRI brain image. first the MRI report of the patient is scanned and convert into computerized form. As it becomes in computerized form, detection of the tumor becomes as simple as clustering is done on that MRI image and manual checking by doctors is avoided. So the results generated are more granular.

The major role of this application is to identify the tumor in the brain image and reconstruct the area which is affected by tumor and based on the threshold value the system will identify whether the image is affected by the tumor or not. Algorithm will cluster the brain image and differentiate the cells into the affected cluster region and unaffected cluster region.

In [4], author uses different segmentation techniques like k means clustering with DWT, fuzzy c means, hierarchical clustering and do their comparative analysis according to efficiency in non-medical format images, efficiency in DICOM images, average time required.

In [6], this paper author uses k means clustering followed by morphological filtering. Morphology is the study of shapes and structures from a scientific aspect. Morphological filters are formed from the basic morphology operations. A structuring element is mainly deserved for any morphological operation. Morphological operations operate on two images, structuring element and the input image.

In [2], this paper, author move for k means clustering algorithm using the Pearson correlation and standardized Euclidean distances has proven useful for obtaining innovative insight from such large-scale biological data sets; however, it is likely to be a computationally acute task, thus demanding a method for accelerating computational performance for high-dimensional biological data.

In [08], this paper research was conducted to detect brain tumor using medical imaging techniques. The main technique used was segmentation, which is completed using a method based on threshold segmentation, watershed segmentation and morphological operators. The planed segmentation method was analyzed with MRI scanned images of human brains: thus discovering tumor in the images. Samples of human brains were seized, scanned using MRI process and then were processed through segmentation methods thus giving effectual end results.

In [11], author presents parallel k-means clustering method. author presented a refined initial cluster centers method to decrease the number of insistent procedures required when grouping. Also studied a parallel k-means algorithm and granted a parallel k-means scheme. An analysis of computational complexity has demonstrated that our scheme can greatly boost the efficiency of the k-means algorithm from both time and space perspectives. The parallelism of the cluster algorithm reveals not only to the area of data mining, but also to that of parallel computing. Research on the advancement and comparableness of cluster algorithms has both theoretical and practical importance.

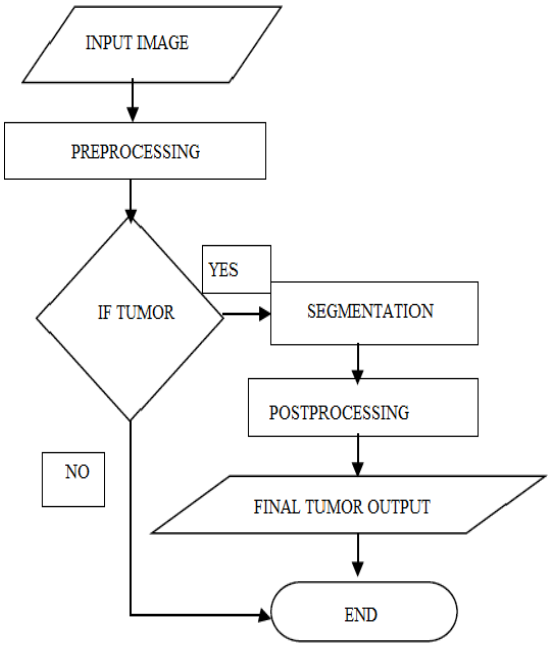

Figure 4: brain tumor detection flowchart[4]

The complete process for detection of tumor from MRI image include some steps like pre-processing , segmentation, post processing. after completing these steps one can get final tumor output with its infected area and seriousness.

III.PREPROCESSING

The MRI image contains labels on the MRI such as patient name, marks and age and some other information which could interfere with the tumor detection is not of use when detecting a tumor. The high intensity value of film artifact are removed from MRI brain image. human brain is symmetric about vertical axis. In the preprocessing, algorithm like histogram matching is correlated before applying segmentation methods. If this algorithm gives location of tumor then only apply segmentation methods.

Algorithm:
Step 1: Given image is divided in four equal parts.
Step 2: As human brain is symmetric about vertical axis, upper two parts correlated on basis of number of pixels present in each intensity level i.e. histogram matching.
Step 3: Step 2 repeated for lower two parts of brain.

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Step 4: if mismatch found in upper two parts' histogram comparison, symmetry disturbed in upper part hence 'tumor present in upper part'
Else if mismatch found in lower two parts' histogram comparison, 'tumor present in lower part'
Else 'tumor not present' in given image[4].

IV.METHODS FOR TUMOR SEGMENTATION

There are number of techniques or methods used for image segmentation. Some of them are thresholding, region growing, classifier, clustering, artificial neural networks, deformable models, level set methods.

A. Thresholding
The easiest method of image segmentation is called thresholding. This method is based on threshold value to turn a gray scale image into binary image. The key of this method is to select threshold value. By grouping all pixels with intensity between two such thresholds into one class segmentation is done. A process to determinate more than one threshold value is known as multi thresholding. In a array of image processing procedure thresholding is used as an initial step. In digital mammography it has been applied in which two classes of tissue are present; one is healthy and other is tumorous [8].

B. Region-growing method
Region growing method rely mainly on the assumption that the neighboring within one region have similar values. The regular procedure is to compare one pixel with its neighbors. if the similarity criterion is satisfied, the pixel can be set to associate to the cluster as one or more of its neighbors. The selection of the similarity criterion is significant and the results are motivated by noise in all instances[5].

C. clustering methods

1) k-means clustering
k means clustering is an iterative technique that is used to partition an image into k clusters.

Algorithm:
1. Pick k cluster centers, either randomly or based on some heuristic
2.Assign each pixel in the image to the cluster that reduces the distance between the pixel and the cluster center
3.Re-compute the cluster centers by equating all of the pixels in the cluster
4.repeat steps 2 and 3 until convergence is attained.

In this case, distance is the squared or entire difference between a pixel and a cluster center. The difference is generally elected based on pixel color, intensity, texture and location, or a weighted combination of these factors. K can be selected manually, anyway or by a heuristic. This algorithm is guaranteed to converge, but but it may not return the optimal solution. The quality of solution depends on the initial set of clusters and the value of k[6].

2) fuzzy c means clustering
In fuzzy clustering, data elements can belongs to more than one cluster, and associated with each element is set of membership levels. These announce the strength of association between the data elements and a particular cluster. Fuzzy clustering is a process of appointing these membership levels, and then using them to assign data elements to one or more clusters.

The FCM algorithm is an improvement of earlier clustering methods. The objective function of FCM algorithm is defined as the sum of distances between the impression and the cluster centers.

D. Level set method
The level set method was initially determined to track moving interfaces. It can be used to efficiently address the problem of curve/surface/etc. generation in an implicit manner. The central idea is to represent the evolving contour using a signed function whose zero corresponds to actual contour, one can easily derive a similar flow for the implicit surface that when applied to the zero level will emulate the generation contour.

E .Genetic algorithm
Genetic algorithm (GA) is an optimization technique for obtaining the best possible solution in a wide solution space. A genetic algorithm operates on populations of strings, with the string coded to represent the parameter set. The first string used for operation is called parent string and newly generated string called child string.

The intensity values of the tumor pixels are treated as initial population for the genetic algorithm. The intensity values of the suspicious regions are then transformed as 8 bit binary strings and these values are then transformed as population strings and intensity values are treated as fitness value for genetic algorithm. After that the genetic operators i.e. reproduction, crossover and mutation are devoted to get new population of strings [13].

F. Artificial neural network
Artificial neural networks are aligned networks of processing elements that affect biological learning. Each element in an ANN is able to perform computations. Learning is achieved through the adaptation of weights assigned to the connections between elements. It is most widely used in medical imaging as a classifier in which the weights are decided by using training data and the ANN is then applied to segment new data. ANNs can also be used in an unsupervised method as a clustering method as well as for nonadjustable models[5].

V. PROPOSED METHOD

Only few techniques are suitable for medical image analysis because of complexity and inaccuracy. There is no standard image segmentation technique that can produce acceptable results for all imaging applications like brain MRI, brain cancer diagnosis etc. difficulties and challenges of brain image segmentation are:

- Traditional K-means algorithm is conscious to the initial cluster centres; cluster results vacillate with different initial input and are easy to fall into local optimal.
- Over segmentation of Image due to limitations of the conservative watershed algorithm.

To overcome the above difficulties we developed an combined k-means clustering based on genetic algorithm. Brain tumor exposure is achieved with the help ofk-means clustering which involves a number of post processes such as visualization and resolution. The k means algorithm is very effective; however, traditional k-means algorithm is delicate to the initial cluster centers. If these clusters fluctuate with different initial input then problem arises [12]. Over segmentation and affectibility to false edges are other difficulties in ordinary k-means method. Determination of exact location and area of brain tumor using k-means method becomes very difficult and hence use of genetic algorithm is suggested. GAs with the change of mutation operations improves the speed of convergence and computing time is reduced also. many experimental results suggest that genetic algorithm based k-means algorithm not only eliminates the over-segmentation problem but provides fast and active clustering also.

VI.CONCLUSION

In this paper we present the study of various segmentation techniques for MRI image segmentation. Also study the concept of tumor and its characteristic and types. All segmentation methods are not suitable for medical image analysis because of complexity and inaccuracy. There are many disadvantages observed while using traditional methods like oversegmentation, moderate speed and less efficiency. To overcome these problem we introduce new method which is combination of traditional k means clustering and genetic algorithm named as ‘k means clustering based on genetic algorithm’.

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