Brain Tumor Detection Using Clustering Method

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ABSTRACT:

The segmentation of magnetic resonance images plays a very important role in medical field because it extracts the required area from the image. Generally there is no unique approach for the segmentation of image. Tumor segmentation from MRI data is an important but time consuming manual task performed by medical experts. The research which addresses the diseases of the brain in the field of the vision by computer is one of the challenge in recent times in medicine. This paper focuses on a new and very famous algorithm for brain tumor segmentation of MRI images by k means algorithm to diagnose accurately the region of cancer because of its simplicity and computational efficiency. In this an image is divided into a number of various groups or clusters. By experimental analysis various parameters such as global consistency error ,variation of information, area, elapsed time and rand index have been measured

Keywords : *area (A), global consistency error, K means, rand index, segmentation accuracy (SA), and variation of information.*

I. INTRODUCTION

Brain cancer is one of the leading causes of death from cancer. There are two main types of brain cancer. They include primary brain cancer, in which the brain cancer originates in the brain itself. Primary brain cancer is the rare type of brain cancer. It can spread and invade healthy tissues on the brain and spinal cord but rarely spreads to other parts of the body. Secondary brain cancer is more common and is caused by a cancer that has begun in another part of the body,such as lung cancer or breast cancer that spreads to the brain. Secondary brain cancer is also called metastatic brain cancer. A diagnosis of brain cancer is generally made by a specialist called a neurologist. Imaging tests that may be performed include MRI and/or CT scan which use computer technology to create detailed pictures of the brain. There are two classifications which exist to recognize a pattern, and they are supervised classification and unsupervised classification. A commonly used unsupervised classification method is a K Means algorithm [1].

II. PROBLEM DESCRIPTION

The tumor portion of an image is exploited by using the undesired component, atmospheric interference. So, the technique which is preferred is image segmentation rather than considering the whole MRI image Various experiments with published benchmarks are required for this research field to progress [1]. A cluster number k must be determined before cluster processing. This method cannot be used to classify data when the value of k is inadequate. If input data comes from an unknown probability distribution, it is difficult to decide a suitable value for k. Some parameters must be provided before cluster processing, and they strongly affect the results. These methods use the minimum distance clustering algorithm as a clustering system. In these methods, input data is treated as multi-dimensional vectors, the degree of similarity between input data is expressed as a distance (e.g, the Euclidean distance), and the classification of the input data is done using these distances.

III. CLUSTERING METHOD FOR SEGMENTATION OF MRI IMAGES

Clustering is a process of partitioning or grouping a given sector unlabeled pattern into a number of clusters [2] such that similar patterns are assigned to a group, which is considered as a cluster [3]. Manual segmentation of brain tumors from MR images is a challenging and time consuming task.In this study a new approach has been discussed to detect the area of tumor by applying K Means algorithm. The area of tumor is calculated and statistical parameters are evaluated.

3.1 K-Means

It is one of the clustering method and is very famous because it is simpler and easier in computation [4]. It is the simplest unsupervised learning algorithms that solve the well known clustering problems. [1] K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their intrinsic distance from each other. The algorithm assumes that the data features form a vector space and tries to find natural clustering in them. The flowchart for the k-means clustering is given below:

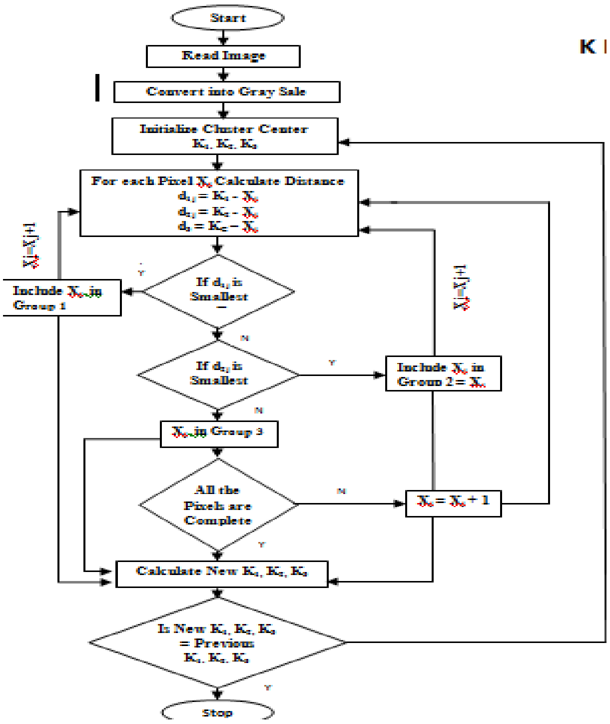


Fig3.1: Flowchart of K Means method (Proposed Method)

IV. RESULTS AND DISCUSSION

By using 6.5 version MATLAB the proposed algorithm has been implemented. The experiment is conducted over two MRI images and various statistical parameters have been evaluated such as global consistency error, variation of information, area, elapsed time and rand index.

4.1 Segmentation Accuracy

The area of the tumor extracted by Ground Truth image should be approximately same as that of the area extracted from the proposed method. Some of the segmentation accuracies are found to be more than 100% which are due to the fact that the brain tumor areas extracted by proposed method are more than the area of ground truth image

4.2 Rand Index

The Rand index counts the fraction of pairs of pixels and pixels are those whose labeling are consistent between the segmentation which was computed and the ground truth averaging across multiple ground truth segmentations [5]. The Rand index measures the similarity between two data clusters. Let there be a set of 'M' elements and two partitions of S for comparison. Now if "p" be the number of pairs of elements in 'S' that are in different sets in X and in different sets in Y "q" be the number of pairs of elements in S that are in the same set in X and in the same set in Y. "r" be the number of pairs of elements in S that are in the same set in X and in different sets in Y."z" be the number of pairs of elements in S that are in different sets in X and in the same set in Y.

$$R = (p + q) / (p + q + r + z)$$

The number of agreements between X and Y is given by p+q the number of disagreements between X and Y is given by and r+z. The values of Rand index lies between 0 & 1. Here '1' shows that the data clusters are exactly the same

4.3 Global Consistency Error

The Global consistency error measures the extent by which one segmentation can be viewed as a refinement of the other [1]. Segmentations which are related are considered to be consistent, since they could represent the same image segmented at different scales. Segmentation is simply a division of the pixels of an image into sets. The sets of pixels are K/as segments. The error is zero when pixel lies in an area of refinement, then one segment is a proper subset of the other. Suppose the manner then there is no relation of subset type.Where two segmentations S1 and S2 are considered as input to segmentation error measure. While the output which is a real valued output in the range [0 1], where no error is shown by '0'. Now the two segmentations S1 and S2 contain a given pixel "p_i".

4.4 Variation of Information

The variation of information represents the distance between two segmentations as the average conditional entropy of one segmentation given the other, and as a result measures the amount of randomness in one segmentation which cannot be explained by the other. Let there be two clustering (a division of a set into several subsets) X and Y where X={X1,X2,………X k }, pi = |Xi| / n,

n = Σ k |Xi|. Then the variation of information between two clustering is:

Vi(X:Y) = H(X) + H(Y) -2I(X,Y)

Where Vi is Variation of information, entropy of X is given by H(X) and mutual information between X and Y is given by I(X,Y) .The mutual information of two clustering is the loss of uncertainty of one clustering if the other is given. Thus, mutual information is positive and bounded by

M.I= {H(X),H(Y)}-$\log_2(n)$.

The tumor portion is correctly segmented if values of global consistency error and variation of information are lower as compared to the value of rand index. The area of segmented portion of ground truth image is approximately same as that of the area of segmented portion of proposed method(K Means method). In this paper values of global consistency error and variation of information are lower as compared to the value of rand index as shown in Table4.1. The segmentation accuracy is good as shown in Table4.2. Area of segmented portion of ground truth image is approximately same as that of the area of segmented portion of proposed method as shown in Table4.3. The elapsed time for the proposed method is very less as shown In Table4.4.The average value of rand index is 0.8358,average value of global consistency error is 0.2792 and average value of variation of information is 2.8596.Rand index is higher than global consistency error and variation of information,which is good approach for segmentation.

Images	Rand Index	Global Consistency Error	Variation of Information
1	0.8587	0.2763	2.3572
2	0.8129	0.2821	2.3621
3	0.7575	0.5263	4.2836

Table 4.1: Variation of Statistical Parameters for different MRI images in Proposed method (K Means method)

Images	Segmentation Accuracy
1	95.892
2	98.892
3	94.786

Table4.2: Segmentation Accuracy for different images

Images	Area 1 (Ground Truth Image)	Area 2 (Segmented Image of Proposed Method)
1	92.3938	92.2583
2	10.0355	10.0345
3	17.6867	17.6552

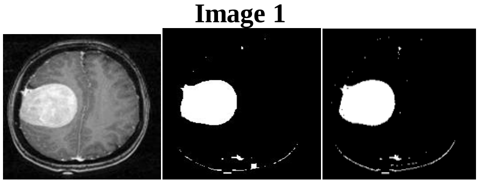
Table-4.3: Comparison of area of ground truth image and segmented image of proposed method

Images	Elapsed Time in Seconds
1	2.261788
2	3.024635
3	3.024365

Table-4.4: Elapsed Time for different images

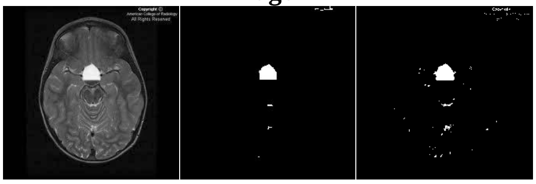
Fig 4.1: Segmented images of Different MRI Images by applying K Means method (Proposed method)
Fig (a): Original MRI image , Fig (b):Ground Truth image, Fig(c): Segmented image of proposed method

Image 1



(a) (b) (c)

Image 2



(a) (b) (c)

Image3

(a) (b) (c)

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