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# MRI Brain Image Segmentation using MST

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**ABSTRACT**: Image segmentation is an important and challenging problem in image analysis in the field of machine vision. For an unsupervised object based segmentation minimum spanning tree based clustering approach will be studied. Minimum spanning tree (MST) is undirected graph which contains all edges and vertex of the graph. We studied the basic algorithm of the MST and implement it. Traditional minimum spanning tree based clustering algorithms give the information about edges contained in the tree to partition a data set and get information about the structure underlying a data set. Also these algorithms apply to the image for segmentation. In this paper, we applied this MST algorithm for Medical image segmentation to find Tumor area.

**KEYWORDS:** Minimum spanning tree, Image Segmentation

## I. INTRODUCTION

Image segmentation, as the name suggests, subdivides the image into its constituent regions and objects. It is a process of dividing an image into different region such that each region is nearly homogeneous, whereas the union of any two regions is not. The term segmentation, in general refers as group of entities. These entities can correspond to words in a speech signal, pixels/contours in an image, point trajectories in a video etc. In this work, we deal with the problem of image segmentation which is the grouping of pixels into meaningful regions. There are many different techniques are present for image segmentation, but there is not a single method which can be considered good for different images. All methods are not equally good for a particular type of image. In this paper, we studied MST algorithm for segmented tumor area in MRI brain image. MST is the graph theoretical image segmentation technique. From the earlier this technique is used for create clusters. In 1926, Otakar Boruvka first introduce minimum spanning tree algorithm and found many application in image segmentation, classification, clustering etc [3]. In MST-based clustering algorithms, a set of *N* data points and defined a distance measure are usually given, and the first step is to construct an MST. Since every pair of data points in the set is associated with an edge, there are $N(N-1)/2$ edges, however only $N-1$ of which are retained in an MST. The time complexity of popular MST algorithms, such as Prim's algorithm is O(N2) [3].

## II. SEGMENTATION METHODS

Image segmentation is the process of portioning image to components and its purpose is to decompose an image to significant and convenient regions and also extract a specific object from image. Segmentation algorithm for monochrome images generally bases on one or two fundamental properties of grey level value: similarity and discontinuity. Image segmentation is basically classified in supervised and unsupervised based image segmentation. Supervised based image segmentation algorithms use a priori knowledge involving the ground truth of a training set of images, while unsupervised algorithms are trained online during segmentation.

Edge detection can be defined as a set of linked pixels that form a border line between two disjoint regions [6]. In this edge based segmentation, there is no need for the detected edges to be closed. There are various edge detectors that are used to segment the image. Laplace edge detector, Robert, Sobel and prewitt operators and canny edge detector. Also region based segmentation technique is also there in which segmentation is carried out based on the similarities in the given image. The region based approach to segmentation seeks to create region directly by grouping together pixels. This pixels share common features into areas or regions of uniformity. Threshold based image segmentation is the simplest method of gray-scale image segmentation. In segmentation, thresholding is used to produce regions of uniformity within the given image based on some threshold criteria T. Thresholding does help in separating the objects from the background; types of thresholding are Global thresholding and local thresholding.

Clustering is "the process of organizing objects into groups whose members are similar in some way". The goal is that the objects within a group be similar to one another and different from the objects in other groups. In partitional

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clustering, user pre-set the number of clusters. An exhaustive enumeration process of all possible partitions is required for achievement of global optimality. In hierarchical clustering, a set of nested clusters organized as a hierarchical tree. A tree similar to diagram that accounts the sequences of merges or splits. In this clustering method, there is no assumption for several particular numbers of clusters. By 'cutting' the dendogram, desired number of clusters can be obtained at the appropriate level.

K-means clustering approach is partitional clustering approach. Each cluster is associated with a center point (centroid) and each point is assigned to the cluster with the closest centroid. In k-means clustering, the number of cluster k must be specified.

## III. MINIMUM SPANNING TREE

MST also called shortest spanning tree which is important concept in graph theory. MST given a graph G = (V, E), where V refer as vertex and E is the edge between two vertex. Otakar Boruvka introduced Minimum spanning tree algorithm in 1926 [1] and has establish broad applications in image classification, segmentation, clustering etc. Zahn proposed Minimum spanning tree (MST)-based clustering in 1971, and abundant developments in the field have made it a significant branch of modern graph based clustering techniques [1]. Afterward, MST has been widely studied for clustering by several researchers in image processing, pattern recognition, biological data analysis, etc.

Minimum Spanning Tree (MST) is a sub-graph that compasses over all the vertices of a given diagram with no cycle and has least entirety of weights over all the included edges. In MST based clustering, the weight for every edge is considered as the Euclidean separation between the end focuses framing that edge. Accordingly, any edge that interfaces two sub-trees in the MST must be the briefest. In such grouping routines, conflicting edges which are surprisingly more are expelled from the MST [1,5,12].

Basically MST have two types of spanning tree algorithm that are prim's algorithm and kruskal's algorithm. In prim's method randomly choose one data point and find the Euclidian distance from that data point to nearest data point. If the distance is minimum compare to other then that data point consider in a spanning tree. Step by step this process is continuous until all data points are covered. In kruskal's clustering algorithm first small clusters are generated. In this method which edges have minimum weight are connected and finally make a large cluster. After making this cluster edge inconsistency is applied to remove largest edge.

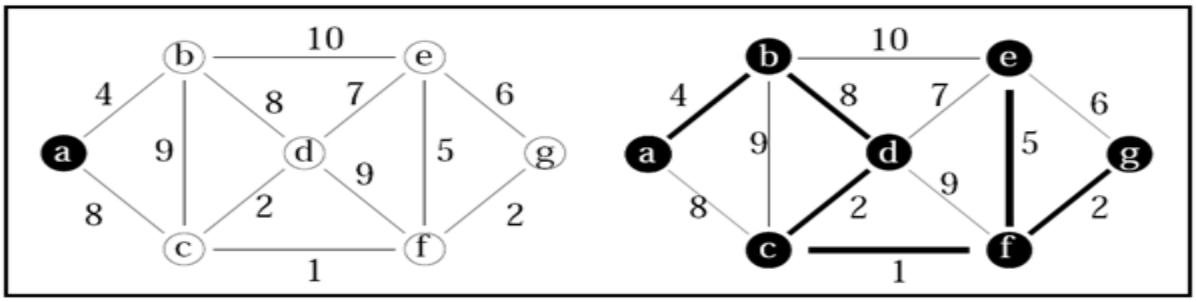


**Figure 1. Prim's MST algorithm**

As shown in figure, randomly point 'a' is chooses, then find the distance between point 'a' and neighboring data points. Accept minimum distance to add neighboring point in the tree. Here nearest point for point 'a' is point 'b', for 'b' nearest point is 'd' , for 'd' nearest point is 'c' and so on. At last the algorithm stop when all node points are covered in a tree.

## IV. NEW APPROACH

For Medical image segmentation normally we used k-means algorithm and fuzzy c means algorithm. In this paper we used graph theoretical method for finding tumor area in MRI brain image. Medical images contain thermal noise or Gaussian noise. For removing this kind of noise median filter is used in this method. Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving

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edges. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. Block diagram of tumor area segmentation is as follows.

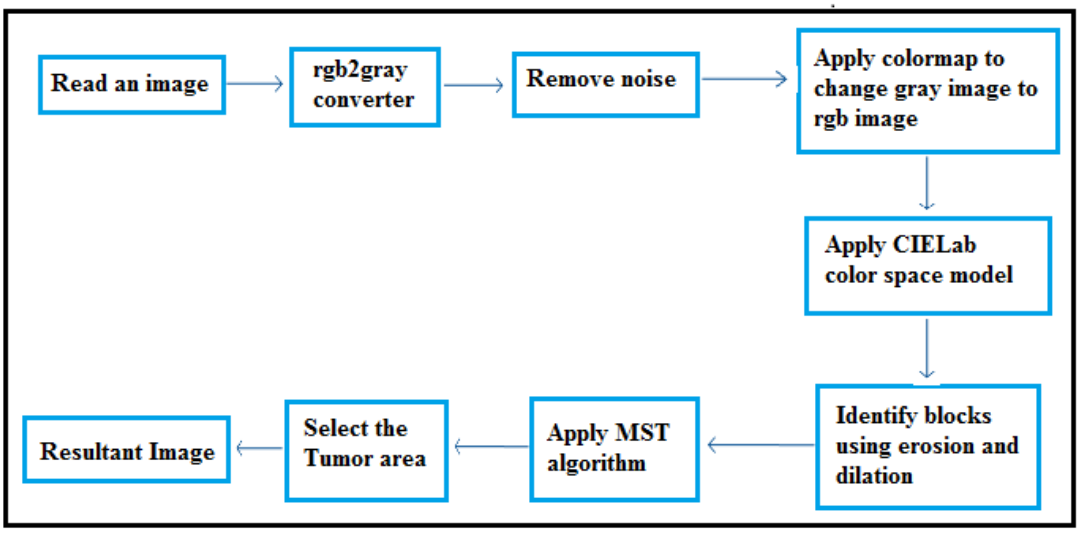


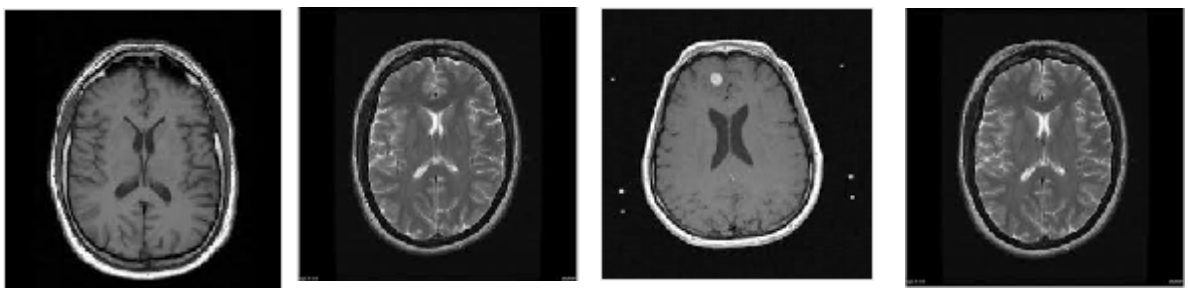

**Figure 2. Algorithm for medical image segmentation using MST**

In this new approach, first read the image. If an image is coloured then convert into gray scale image. Median filter used for removing the any present noise. In next step Apply colour model to convert gray image into RGB image. Apply colour space model CIELab. Use erosion and dilation to find local minima and local maxima from image. These measurements used to identify the segmented area. Then, using graph theory concept of MST select the Tumor area. At last we get the segmented Image.

## V. RESULT AND DISCUSSION

For Medical image segmentation normally we used k-means algorithm and fuzzy c means algorithm. In this paper we used graph theoretical method for finding tumor area in MRI brain image. Medical images contain thermal noise or Gaussian noise which is removed by median filter. In this section first row of image (a) represent original MRI image. Second row (b) represent color image with applying color map method. Then image (c) shows image boundaries, image (d) represents result of morphological operation and last image (e) represent segmented image using MST.

**(a)**



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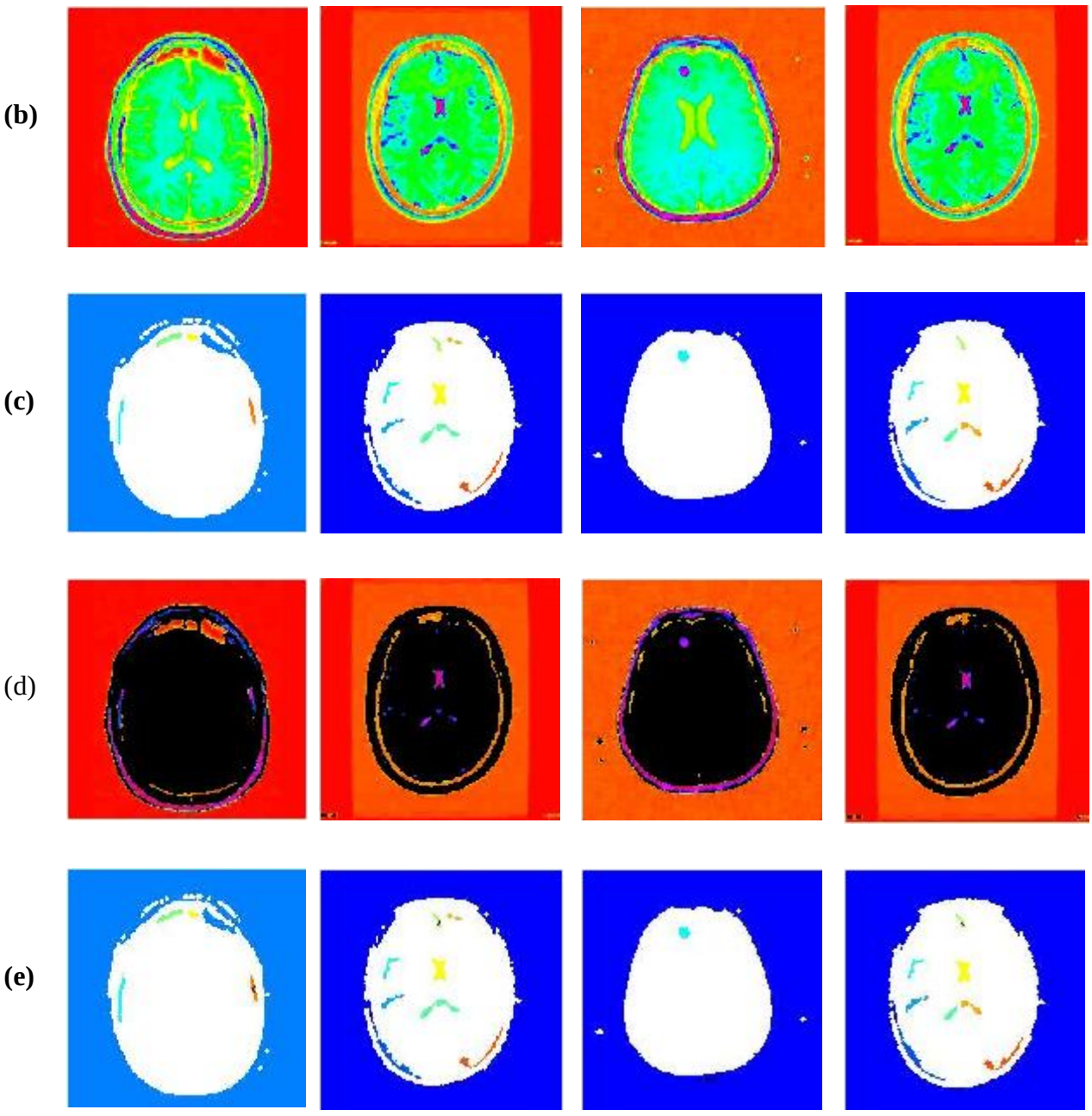


**Figure 3. shows segmented medical image (a) original image (b) colored MRI brain image (c) image showing boundaries (d) Segmented MR brain image using MST (e) Image showing tumor area.**

By using this method we get appropriate result not as much of time means this algorithm is work very fast as compare to other algorithm like k-means. Here we compare k-means and our algorithm with run time.

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**Table 1. Execution time for k-means and MST**

| Methods | Execution time in second |
|---|---|
| K means | 6.195268 sec |
| MST | 0.190213 sec |

## VI. CONCLUSION

By implementing k means algorithm for non-linear data set chance of failure and unable to handle noisy data and outliers. For k-means, randomly choosing of the cluster centre cannot lead to the fruitful result and Euclidean distance measures can unequally weight underlying factors. Minimum spanning tree is used graph based segmentation techniques which has less execution time compare to k means.

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