Efficient Fuzzy Based Method for Brain Tumor Segmentation on MR Images

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Abstract— Traditional image processing and segmentation pursued by association in computer vision assumes that the segmentation is able to remove the object of attention from the background image.. Medical images are generally ambiguous. If objects of interest and their boundaries are found correctly, meaningful information that is visual be provided to the physicians, making the following analysis easier. Inside the image that is numerous algorithms, active contour model is widely used along with its clear bend for the object. In line with the curve representation, there are two main types of active contour models: parametric models and models being geometric. Parametric contour that is active usage parameterized curves to express the contours The model requires a curve that is constant to detect the boundary of the image. This paper proposes a new method of segmentation that address medical image segmentation based on hybrid clustering approach with level set method.

Keywords— Image Segmentation, Medical Images, Segmentation Methods, MRI, Clustering

I. INTRODUCTION

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation [1] is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.
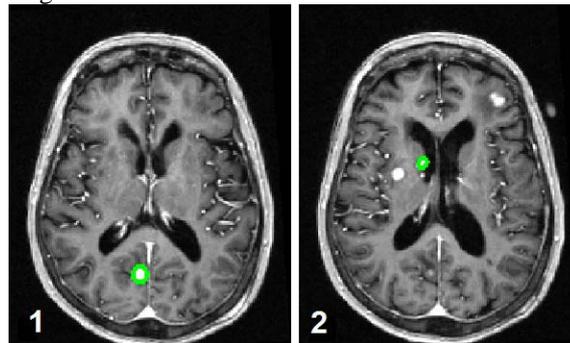

Fig 1: Example of aBrain MRI Image Segmentation

Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic. According to segmentation method, we can approximately categorize them into region-based segmentation, data clustering and edge base segmentation. Image segmentation is useful in many applications. It can identify the regions of interest in scene or annotate the data. Region-based segmentation includes the seeded and unseeded region growing algorithms. The goal of segmentation is typically to locate certain objects of interest which may be depicted in the image, segmentation could therefore be seen as a computer vision problem. Several general-purpose algorithms and techniques have been developed for image segmentation. To be useful, these techniques must typically be combined with a domain's specific knowledge in order to effectively solve the domain's segmentation problems.

II. RECENT IMAGE SEGMENTATION METHODS

Human eyes can distinguish thousands of colors but can only distinguish 20 kinds of gray-scale, so we can easily and accurately find the target from the color images. However, it is difficult to find out from the gray-scale image. The reason is that color can provide more information than gray-scale. The color for the pattern recognition and machine vision is very useful and necessary. At present, specifically applied to the color image segmentation approach is not so much as for the

gray-scale images, most of proposed color image segmentation methods are the combination of the existing gray-scale image segmentation method on the basis of different color space. Commonly used for color image segmentation methods are histogram threshold, feature space clustering (FCM & C-Means Clustering), region-based approach, based on edge detection methods, fuzzy methods, artificial neural network approach, based on physical model methods, etc.

Thresholding Methods

Makes decisions based on information from local pixels and is effective when the intensity levels of the objects fall squarely outside the range of background levels. Because spatial information is ignored, however, the boundaries blurred region can wreak havoc. Boundaries and borders region are closely linked, because there is a strong coordination on the edge of the area. Therefore, edge detection techniques have been used as the basis for the other segmentation technique. The edges identified by edge detection are often disconnected. Limits of a closed segment of the object regions is required to from an image. Discontinuities are bridged if the distance between the two edges is a predetermined threshold [4].

Edge based Methods

These Methods mainly centered around the edge detection. Weakness in connecting together broken contour lines which make it as prone to failure in the presence of blur [5]

Region based Methods

A method based on the region generally proceeds as follows: the image is divided into connected regions by grouping neighboring pixels of similar levels of intensity. Adjacent regions are then merged under some criterion involving perhaps homogeneity or sharpness of borders in the region. More stringent criteria result in fragmentation, given the blurred boundaries and light fusion [6].

On the basis of relaxation-preserving connectivity This segmentation method, generally referred to as the active contour model begins with a certain initial shape shown at the limit of the shape of the curves of the vertebral column and the updated iteratively by applying various operations to contraction / expansion in function with an energy function. Although the model of energy minimization is not new, the coupling with the maintenance of a yield model gives an interesting new twist, as usual with this kind of methods, being trapped in a local minimum is risk against which we must protect.

Graphics can be used effectively for image segmentation. In general, a pixel or group of pixels are the vertices and edges define the difference between the pixels in the neighborhood.

Some popular algorithms in this category are random Walker, minimum average cut algorithm based on minimum spanning tree, cut standard, etc. The method of "standard" cuts was proposed by Shi and Malik in 1997. In this method, the image to be segmented is modeled as a weighted undirected graph. Each pixel is a node in the graph, and an edge is formed between each pair of pixels. an edge weight is a measure of the similarity between the pixels. the image is divided into disjoint sets by removing the edges that connect the segments. the optimal distribution of the curve is the one which minimizes the weight of edges have been removed.
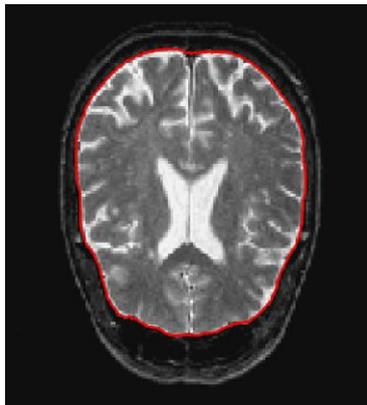

Fig 2: Region BasedSegmentation Methods

Mathematical Morphology

Mathematical morphology geometrical structure of the image is examined by probing with small patterns, called "structuring elements? Size and different shape. This procedure allows operators to nonlinear image are well suited to the exploration of geometric and topological structures [7].

Mathematical Morphology is a retrieval of image components that are useful for representation and description tool. Morphology can provide boundary objects, skeletons and convex hulls. It is also useful for the treatment of many techniques before and after, in particular edge thinning and pruning.

The main application of morphology occurs on binary images, but also images in grayscale. It may also be useful in image distance. (An image is a range where the gray levels representing the distance from the sensor to objects in the scene, rather than the intensity of the light reflected by them).

Mathematical morphology has several advantages over other techniques, particularly when applied to image processing such as edge information preserved, works by using a treatment based on shape, can be designed to be idempotent

effective calculation. The morphology has been used in a wide range of applications. Some possible applications include image enhancement, image restoration, edge detection, texture analysis, noise reduction.

Split and Merge Methods

Split-and-merge Segmentation is based on a partition of the quad tree of an image. Sometimes called quad tree segmentation. This process starts at the root of the tree representing the entire image. If it is non-uniform (homogeneous), and is divided into four square children (division process), and so on so forth. Conversely, if square four children are homogeneous, that can be combined in several connected components (melting process). The node of the tree node is a segmented. This process continues recursively until no splits or mergers are possible [8].

Narayan Subudhi et al., 2015 illustrates countless methods are obtainable into the literature. Based on several experiments among the most accepted methods is span growing. Research on period producing, though, has concentrated chiefly in the design of feature extraction as well as on creating and criterion that is merging. Most of these methods have dependence that is inherent the order in that the points and spans are examined. This flaw implies that segmented consequence is sensitive and painful to the selection of the early points that are producing prone to over-segmentation. This paper presents a framework that is novel circumventing anomalies like over-segmentation. In this article, we now have counseled frontier segmentation that is for maintaining the segmenting aerial images. This way implicates the preservation of boundaries ahead of segmentation of photos, thus noticing perhaps the discontinuities that are frail.

Christopher Herbon et al., 2014 There have currently been improvements in the span of fully detection that is automatic of objects in color images. State regarding the art that is fine join detection alongside segmentation. In this paper we display why these methods can be signicantly enhanced by familiarizing a new association that is iterative statistical modeling, and segmentation procedure. The technique that is counseled a detect-and-merge algorithm, that iteratively ands and validates new objects and later updates the statistical ideal, as meeting in extremely insufficient iterations.

R. Loganathan et al., 2013 addresses health image compression, as extra and wellness that is extra are digitized, frugal and competent information compression technologies are demanded to minimize the storage volume of wellness database in hospitals. The Expanse of Attention (ROI) – representing the diseased portion - in a health picture is segmented using alert contours in this paper. The ROI removed are next compressed employing compression that is lossless uphold the integrity. A novel Biorthogonal wavelet and Embedded Zero Tree (EZW) is counseled for compression technique. Experimental aftermath clarify that the technique that is counseled enhances the Top Gesture to Sound Ratio (PSNR) for the wellness image compression.

M. Lalitha et al., 2013 The aim of this survey on disparate clustering practices is to accomplish photo segmentation. Clustering can be termed here as a gathering of comparable images. The intention of clustering is to become consequence that is significant competent storage and quick retrieval in various areas. The goal is to furnish a report that is self-contained of thoughts and also the math underlying clustering techniques. Next the clustering methods are given, tear into: hierarchical, partitioning, density-based, model-based, grid-based, and methods that are soft-computing. The purpose of this study is to furnish a study that is comprehensive of clustering and picture segmentation techniques. As a result of significance of photo segmentation and clustering a true number of algorithms have been counseled but founded in the image that is inputted the algorithm ought to be selected to get to be the best results.

Hakeem Aejaz Aslam et al., 2013 presents a way that is new picture segmentation using Pillar K-means algorithm. This segmentation method includes a mechanism that is new gathering the agents of elevated resolution pictures in order to improve accuracy and cut the computation time. The arrangement uses K-means for picture segmentation optimized by the algorithm later Pillar. The Pillar algorithm considers the arrangement of pillars should really be placed as remote from every supplementary that is single challenge the stress allocation of a rooftop, as alike as the range centroids amid the data circulation. This algorithm is able to optimize the K-means clustering for picture segmentation within the aspects of computation and accuracy time. This algorithm distributes all early centroids based on the maximum distance that is cumulative. This paper evaluates in the way which counseled picture segmentation by contrasting alongside K-means clustering algorithm with level set method and Gaussian combination.Experimental aftermath elucidate the effectiveness of our way to enhance the segmentation accuracy and quality aspects of computing time.

III. PROPOSED WORK

Fuzzy Clustering involves the job of dividing data points into homogeneous classes or clusters making sure that items in the class that is same as similar as you can and products in different classes are as dissimilar as possible The algorithm start with data scanning, in this items are identified and their domain is find out. for every single similarity that is domain of item is learn with another product, as similarity is determined for every single and every item in a domain. Similar items are then identified in a domain by applying similarity algorithm. Candidates are generated after finding items being similar a domain. Exponential Weight of each candidate is calculated. Evaluation of applicants are done on such basis as fat calculated, so that weight is more or less then the given weights. After evaluation cluster center is identified and all sorts of the nearby points that having the distance similarity are grouped together and clusters are formed. Then this output that is clustered based on similarity.

Brain tumor segmentation process consists of splitting the tumor that is of different such as for example solid tumor, edema, and necrosis from the normal mind cells, such as gray matter (GM), white matter (WM), and cerebrospinal fluid (CSF). Although manual segmentation by qualified professionals remains superior in quality to methods which can be automated it has two disadvantages. The drawback that is first that producing manual segmentations or semi-automatic segmentations is incredibly time-consuming, with higher accuracies on more finely detailed volumes demanding increased

time from doctors. The second problem with manual and semiautomatic segmentations is that the segmentation is subject to variations both between observers and within the observer that is exact same.
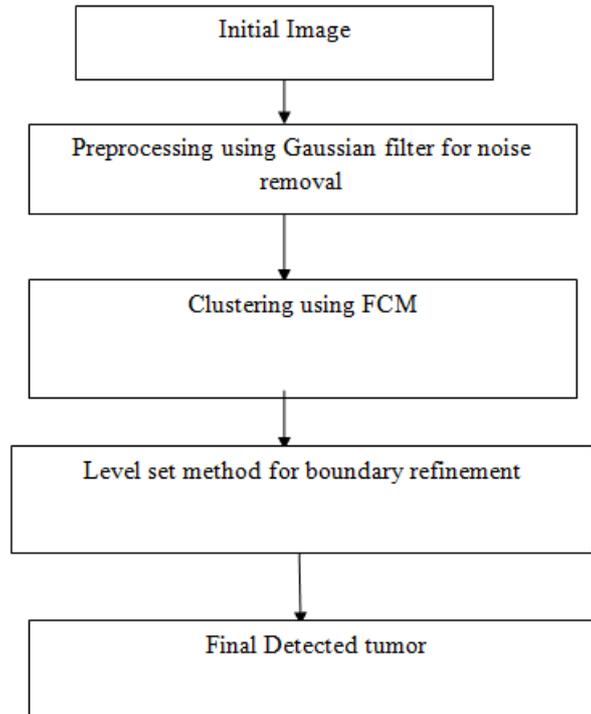
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┌─────────────────────────────┐
│        Initial Image        │
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│      Final Detected tumor    │
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Fig 3. Framework of Proposed System

The level set method for capturing fronts that are moving, the technique has been shown to be a robust numerical device for this purpose in a diverse collection of problems over time. One set of problems is based on the field of image technology. In this essay, we shall emphasize not just exactly what has been done in image technology level that is utilizing techniques, but additionally in other area of sciences where the level set techniques are used successfully the idea is to point out the related formulations and solution practices to your image science communities. These communities include image/video processing, computer vision, and graphics, they are diverse, with specialties such as medical imaging and Hollywood kind effects that are special. Allow us begin with a quick assessment of what constitutes a level that is classical technique: an implicit information representation of a hypersurface, a set of PDEs that govern exactly how the area moves, and also the matching numerical means of implementing this on computer systems. In reality, an application that is typical image technology may well need all these features. We will illustrate this aspect by some applications that are traditional
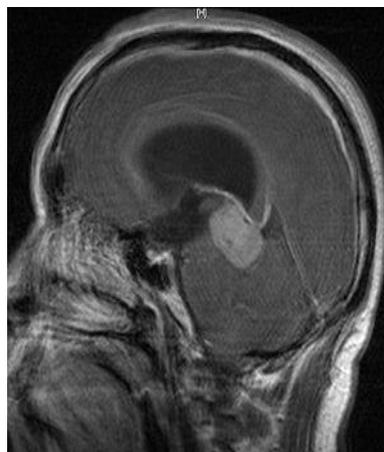

Fig 4: MRI Image with Tumor

The fast matching algorithm expands from a seed point to the object boundary until it encounters a pre-set difference in the pixel's intensities.

Active contours evolve an initial contour in time according to multiple intrinsic geometric measures of the image. A grey value penalty and a curvature constraint which prevents them from leaking the object boundary at areas of bad edges in the plugin implementation the measures are a side based constraint. During curve evolution the active contours in this implementation can split and merge and thus be used to detect even multiple objects. The algorithm in the plugin is based on a state-of-the-art memory efficient and fast sparse-field computation which can be easily extended to other variations of the active contour/level set algorithms.
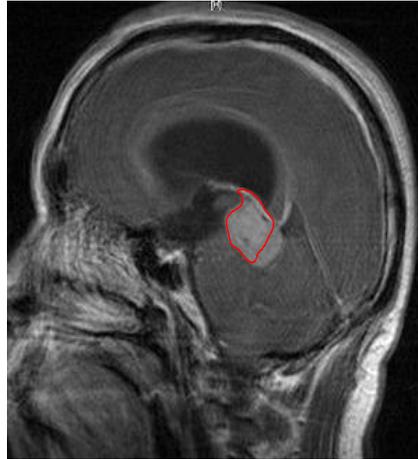
Fig 5: Segmented tumor with Level set method

IV. EXPERIMENTAL RESULTS

Data sets:- In order to check the performance of our image segmentation approach, we used realistic data sets collected from the authorized MRI Imaging center.

Results: In this section, we show the results of our proposed image segmentation technique that obtained using real MRI brain images This work was implemented using MATLAB (R2015a). We run our experiments on a core i3/2.4 GHZ computer with 3 GB RAM .

Table 1. Computation time of Fuzzy C-Means Clustering varying with proposed FCM Level set Method

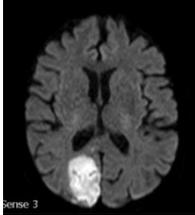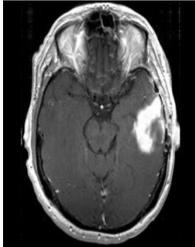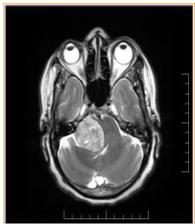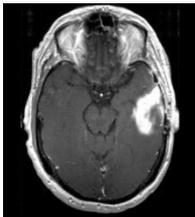| Images	FCM(sec)	FCM Level Set(sec)
1	0.8611	0.8956
2	0.8611	0.8956
3	0.6553	0.835
4	0.7415	0.9787
5	0.8366	0.4938
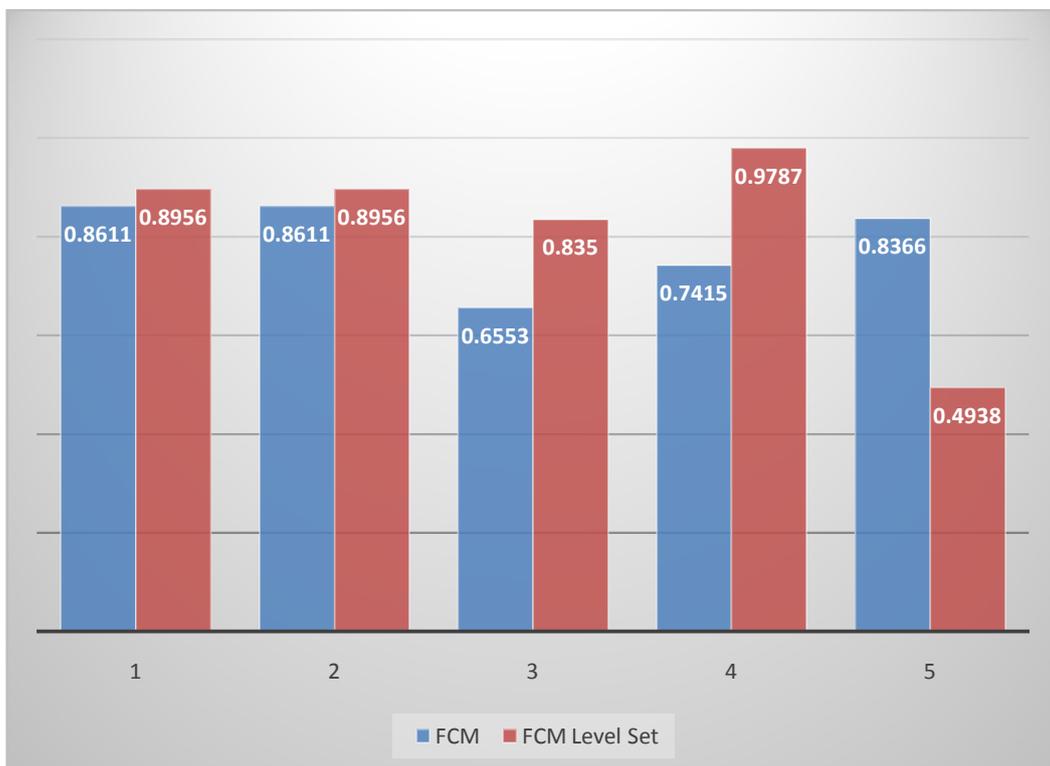
Fig 6: Dice Similarity of the Level Set method (red) compared with FCM(blue)

Table 2:-Elapsed time Metrices of FCM varying with no. of Iterations

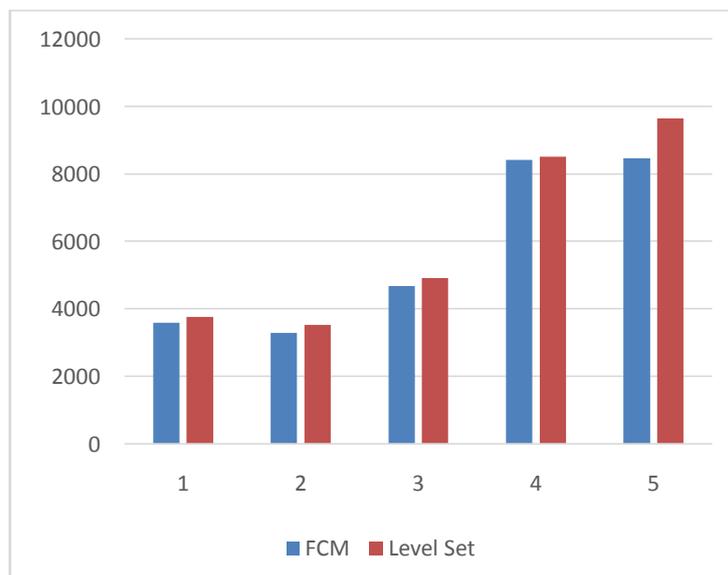| Data set	FCM	Iteration no.	Time (seconds)	Iteration no.	Time(seconds)
1		15	2.855619	10	1.681178
2		15	8.129520	10	5.604556
3		10	2.947505	5	1.869475
4		7	7.577656	4	5.027032
5		20	34.660923	4	6.525936
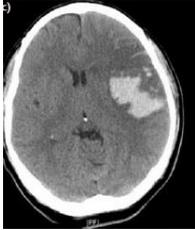
Fig 7: No of Pixels Segmented Using FCM and Level Set method.

V.   CONCLUSION

Image segmentation is a vital research span because it plays a frank act in picture research, and understanding. Segmenting a picture is the most challenging and tough task because continue disparate objects and a huge variation amid them employing a finished framework. Consequently, scanned documents have to frequently be segmented beforehand supplementary document processing methods, such as compression or rendering, can be applied. Instituted ways to document segmentation, normally involve partitioning the document pictures into blocks, and next categorizing every single block

The aftermath displays that fuzzy LevelSet Segmentation can prosperously segment a tumor endowed the parameters are set properly in MATLAB environment. Watershed Segmentation algorithm presentation is larger for the cases whereas the intensity level difference amid the tumor and non-tumor spans is higher. It can additionally segment non homogenous tumors bestowing the non-homogeneity is inside the tumor region. This proves that methods aimed at finished intention segmentation instruments in health imaging can be utilized for automatic segmentation of Brain tumors. Furtherwork can be carried out to make this methodautomatic so that it can calculate the dimensions ofthe segmented tumor automatically.

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