International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

A Novel Set Level Technique for Image Segmentation Using Fuzzy Clustering and Self Organizing Map Network

Nidhi Kaushal[1], Murlidhar Vishwakarma[2], Ravi Singh Pippal[3]

[1]Department of CSE REC College, Bhopal (M.P), India
[2]Department of CSE REC College, Bhopal (M.P), India
[3]Department of CSE REC College, Bhopal (M.P), India

Abstract: ***Image segmentation plays an important role in computer vision or in image processing such as segmentation in video and tracing object of interest, remote sensing, medical treatment and diagnose, for critical disease analysis. In segmentation process all the traditional methods like FCM and K-means are not performed well results in terms of global consistency error and elapse time. The process of image segmentation method also suffered from noise content in image, noise part of image decrease the performance of image segmentation process. For the improvement of image segmentation technique we use fuzzy based clustering technique with some objective function SOM. The motivation is to segment the image with fuzzy based clustering technique with some objective function SOM can enhance the performance.***

Keyword: FCM, SOM, Image segmentation, LBM, Clustering

1. Introduction

In image processing, segmentation is an important and difficult task which aims to partition a given image into several regions or to detect an object of interest [1].Segmentation of image is a process of partitioning a digital image into N number of parts. The images are segmented on the basis of set of pixels or pixels in a region that are similar on the basis of some homogeneity criteria like color, texture intensity, which helps to locate exact place and identify objects or boundaries in an image [2]. In terms of mathematical formula, Image segmentation divides a digital image f(x, y) into continuous, disconnect and nonempty subset. These subsets higher level information can be easily extracted. Practical applications of image segmentation include object identification and recognition, facial recognition, medical image processing, criminal investigation, security system in airport, satellite images, quality assurance in factories, etc. Due to the importance of the image segmentation, large numbers of algorithms have been proposed but the selection of the algorithm purely depends upon the image type and the nature of the problem [2].

Clustering is grouping process of objects into different groups known as clusters. In commonly the clustering algorithms can be categorized into two parts. First one is hard clustering and another one is soft (fuzzy) clustering. In hard clustering, the data are divided into fixed number of clusters, where each data element can belongs to exactly single cluster. In soft clustering, data elements can belongs to one or more cluster, and associated with each element is a set of membership levels. Fuzzy c means clustering algorithm have at the latest been shown to yields good output in a large variety of real world application Clustering is a mathematical tool that attempts to discover structures or certain patterns in a dataset, where the objects inside each cluster show a certain degree of similarity. It can be obtained by different algorithms that differ considerable in their belief of what compose a cluster and how to efficiently find them [3].

In the LSM, the movement of the zero level set is actually driven by the level set equation (LSE), which is a partial differential equation (PDE). For solving the LSE, most classical methods such as the upwind scheme are based on some finite difference, finite volume or finite element approximations and an explicit computation of the curvature [4]. Unfortunately, these methods cost a lot of CPU time.

Recently, the lattice Boltzmann method (LBM) has been used as an alternative approach for solving LSE [5], [8], [6], [7]. It can better handle the problem of time consuming because the curvature is implicitly computed and the algorithm is simple and highly parallelizable.

2. Related Work

This section gives an extensive literature survey on the existing image segmentation method. They study various research paper and journal and know about image segmentation method based on clustering and classification algorithm. But some related work in the field of image segmentation method on the basis of clustering and classification algorithm.

Author describe the method for image segmentation the description are, Using the gradient descent method, they found the corresponding level set equation from which draw conclusion a FEF to the LBM solver based on the Zhao model. The method is robust against noise, fast, independent of location of the opening contour, powerful in the existence of intensity in homogeneity, highly synchronizable and can find objects with edges or without too. An experiment on medical and real-world images shows the performance of the proposed method in terms of efficiency and speed [9].

2) Author proposed a novel algorithm for interactive image segmentation, based in cellular automaton. Experiments have shown that user effort required for segmenting generic photos and medical images is rather modest, no harder than in state-of the art graph based methods like Graph Cuts, Grab Cut and Random Walker. Proposed method combines the advantages, distributed between the mentioned methods(multi-label segmentation, N-dimensional images processing, speed high enough for interactive segmentation), and offers more-algorithm extensibility by varying the automaton evolution rule, more interactivity and user control of the segmentation process [7].

3) Author described a novel method for detecting and localizing objects of a visual category in cluttered real world scenes. This segmentation is then in turn used to again improve recognition by allowing the system to focus its efforts on object pixels and to discard misleading influences from the background. Our approach considers object categorization and figure ground segmentation as two interleaved processes that closely collaborate towards a common goal. The core part of our approach is a highly flexible learned representation for object shape that can combine the information observed on different training examples in a probabilistic extension of the Generalized Hough Transform [10].

4) Author talk out about the situation of problem of detecting irregularities in visual data, means Detecting of doubtful behaviors in video sequences, or define salient patterns in images. They shows the problem of finding the legitimacy of visual data as a process of making a riddle: They try to makes a new behold image area or a new video segment ("the query") taking part of data ("pieces of puzzle") fetched from already made visual examples ("the database"). The word "irregular" based on the theme in which the "regular" or "valid" are declared. It's not feasible to look forward to explicit definition of all presumable valid endowment for a given context yet. Area in the supervision data which can be constructed using big contiguous part of data from the database are took very likely, whereas areas in the checked data which cannot be constructed from the database are regarded as unlikely/suspicious. The problem is posed as an interconnection of process in a probabilistic visual model. They represent applications of this approach to matching saliency in images and video, for finding doubtful behaviors and for automatic graphical inspection for quality assurance [11].

5) Author discuss about the image segmentation method and the details are, The multiphase level set formularization is latest and of liking on its own: through construction, The problems of vacuum and overlap is avoid by itself; it required only log n level set functions for making n phases in the piecewise constant case; With the help of complex topologies, including triple junctions it can represent boundaries; in the piecewise smooth case, In order to represent any partition only two level set functions formally sufficient, based on The Four-Color Theorem [12].

6) Author discuss about the image segmentation method and the details are, The multiphase level set formularization is latest and of liking on its own: through construction, The problems of vacuum and overlap is avoid by itself; it required only log n level set functions for making n phases in the piecewise constant case; With the help of complex topologies, including triple junctions it can represent boundaries; in the piecewise smooth case, In order to represent any partition only two level set functions formally sufficient, based on The Four-Color Theorem [13].

3. Proposed Model

Image segmentation is very important area of research in the field of computer vision and object detection. Image segmentation refers to partitioning an image into several disjoint subsets, such that each subset corresponds to the meaningful part of image.

In proposed method a set level method based image segmentation technique using self-organized map network. The proposed algorithm used FCM clustering algorithm, set level technique and SOM network. In the continuity of chapter discuss FCM algorithm, Set level function energy function, SOM network, proposed algorithm and proposed model for image segmentation.

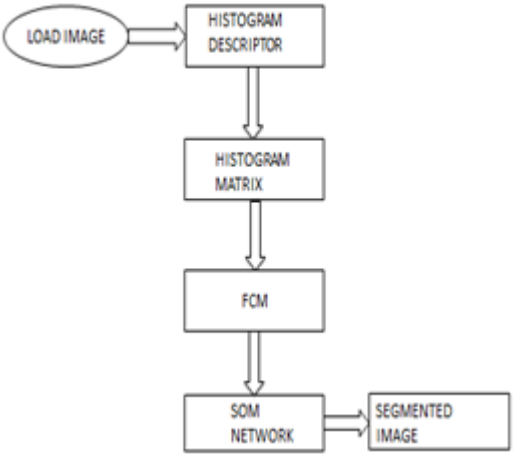

Figure 1: Block diagram of proposed method

The proposed algorithm for set level image segmentation using self-organized map network and fuzzy c-means algorithm. The set level method is adaptive counter based technique, in this technique counter area decide the level of segmentation. For the extraction of feature in set level technique used counter extraction. The counter value extraction performs by edge detection technique. The edge detection technique measures the boundary value of feature. For those task used energy function for estimating the feature value. The image features are extracted from the image using energy function. SOM acts as a clustering mechanism that projects N-dimensional features from the energy function into an M-dimensional feature space

4. Proposed Algorithm

Step1. Initially input image passes through energy function and process into counter level set function.

Step2.the extracted area of counter feature is passed through FCM algorithm.
Step3. After processing of number of cluster c1, c2 ….cn pass through self-organized map network.
Step4. In phase of feature mapping in feature space of SOM network create a fixed cluster according to objective function.
Step5. Here show steps of processing of SOM network

1. Define weight of each node value.
2. Present the cluster to the SOM which is selected from training data set.
3. All nodes satisfied the minimization of objective function.
4. The radius of the area around the objective is calculated. With each iteration the size of area Decreases.
5. Every node in the objective function area has its weights adjusted to become more like the objective. Nodes closest to the objective are changed more than the nodes furthest away in the neighborhood.
6. Repeat from step 2 for enough iteration for convergence.
7. Calculating the objective is completing by the Euclidean distance between the node's weights (W_1, W_2, …, W_n) and the input vector's values (V_1, V_2, …, V_n).
8. This returns a good gauge of how equivalent the two sets of data are to each other.
9. The addition of old weight and fraction (L) which is the difference in between two, input vector and old weight, shows new weight for a node. Now set (theta) depends on distance from the BMU.
10. The L is learning rate which and also an exponential decay function.
11. Showing the SOM converge.
12. Time constant shows by lambda, and t denoted as time step

Step6. After processing of SOM network out data of image is segmented is done
Step7. Finally gets segmented image and estimate the elapsed time.

5. Experimental Analysis

To investigate the effectiveness of the proposed method for various images segmentation algorithms such as Fuzzy clustering method (FCM), Boltzmann method and self organizing map (SOM) network etc. We used MATLAB software 7.14.0 and some data set of images using with using some images such as Brain, Flower etc.

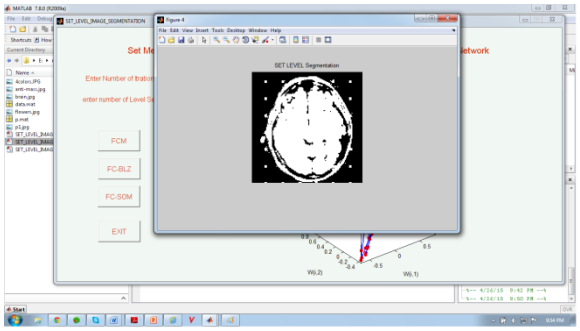

Figure 2: Shows the segmentation process on brain image

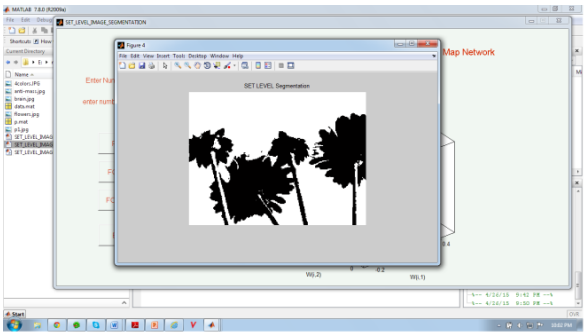

Figure 3: Shows the segmentation process on Flower image

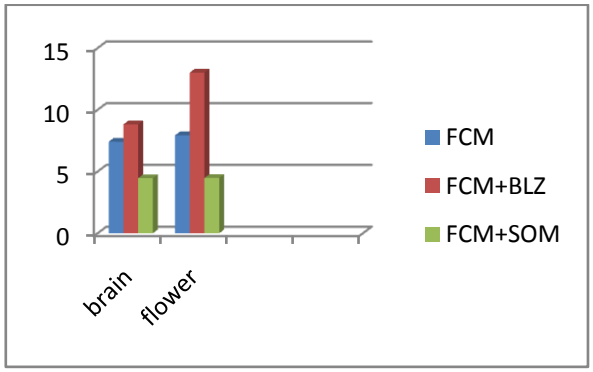

Figure 4: Shows all three methods with 100 Iteration and level set 5

Table 1: Result of all three methods with 100 Iteration and level set 5

S. No	Elapsed time		
	FCM	FC-BLZ	FC-SOM
1	7.416422	8.818834	**4.463222**
2	7.931225	13.015264	**4.478822**

6. Conclusion and Future Work

The process of image segmentation is combination FCM and SOM network. The proposed algorithm is very efficient in elapsed time. The set level function is basically a part of adaptive counter extraction technique. Counter based image segmentation process defines the boundary value of segmented area of image. In the process of image segmentation fuzzy c-means (FCM) algorithm play an important role. Basically the FCM algorithms process the

number of cluster and center point generation of cluster. For the improvement of segmentation process FCM algorithm combined with self-organized network. The self organized map network is very famous unsupervised neural network model used for data clustering.

The proposed algorithm for image segmentation is very promising result shows in terms of reduces value of elapsed time. The reduces value of elapsed time improved the segmentation process of proposed algorithm. For the improvement of FCM algorithm used SOM neural network model, these models improve the effectiveness of segmentation process. The composite form of proposed algorithm increases the complexity of algorithm. In future used another optimization technique such as ANT, GA and POS and reduces the time complexity of algorithm.

References

[1] S., Osher and J., Sethian "Fronts propagating and curvature dependent speed: algorithms based on Hamilton-Jacobi formulations" Journal of Computational Physics, vol. 79, November1988, pp 12-48.
[2] Rajeshwar Dass, Priyanka, Swapna Devi "Image Segmentation Techniques" IJECT, Vol. 3, Issue 1, Jan- Mar 2012, pp 66-70.
[3] R.Suganya, R.Shanthi "Fuzzy C- Means Algorithm- A Review" International Journal of Scientific and Research Publications, Volume 2, Issue 11, November 2012, pp 1-3.
[4] S. Osher and R. Fedkiw, "Level Set Methods and Dynamic ImplicitSurfaces" New York: Springer-Verlag, 2003.
[5] Y. Chen, Z. Yan, and Y. Chu "Cellular automata based level setmethod for image segmentation" IEEE/ICME, 2007.
[6] Karline Soetaert, Thomas Petzoldt and R. Woodrow Setzer "Solving Differential Equations in R"The R Journal Vol. 2 issue 2, December 2010, pp5-15.
[7] Vladimir Vezhnevets, VadimKonouchine "GrowCut--Interactive Multi-Label N-D Image Segmentation By Cellular Automata" 2007, PP 340-347
[8] S. Balla-Arabé and X. Gao "Image multi-thresholding by combining thelattice Boltzmann model and a localized level set algorithm" Neurocomputing, vol 93, Sep. 2012, pp106-114.
[9] SouleymaneBalla-Arabé, XinboGao" A Fast and Robust Level Set Method for Image Segmentation Using Fuzzy Clustering andLattice Boltzmann Method" IEEE TRANSACTIONS ONSYSTEMS, MAN, AND CYBERNETICS, vol 43, Issue3 2012.
[10] Bastian Leibe, Ales Leonardis, and BerntSchiele" Robust Object Detection with Interleaved Categorization and Segmentation" IJCV Special, Learning for Vision and Vision for Learning. 2007 pp 1-26.
[11] OREN BOIMAN AND MICHAL IRANI" Detecting Irregularities in Images and in Video" International Journal of Computer Vision 74, Springer 2007. Pp 17-31.
[12] H.D. Cheng, X.J. Shi, R. Min" Approaches for automated detection and classification of masses in mammograms" Pattern Recognition 39, 2006. Pp 646-668
[13] LUMINITA A. VESE AND TONY F. CHAN" A Multiphase Level Set Framework for Image Segmentation Using the Mumford and Shah Model" International Journal of Computer Vision 50, 2002. Pp 271–293