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Spatial Fuzzy Clustering With Level Set Method for MRI Image

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Abstract: Medical Image processing is one of the most challenging topics in research field. Magnetic Resonance Image (MRI) plays a major role in Medical diagnostics. This Paper Present the image segmentation, tumor detection, area calculation and stage of tumor. Fuzzy c means clustering is used for bias estimation and correction. SFCM (spatial fuzzy clustering) is proposed for image segmentation. Spatial fuzzy level set is proposed to clustering and tumor detection. The segmentation of brain MRI, tumor is detected and it's identified exact location of tumor. After level set operations, tumors appear as pure white color on pure black backgrounds. The area of tumor calculates the white pixels in binary image.

Keywords: MRI, Bias estimation, SFCM, level set method, Brain tumour.

I. INTRODUCTION

Medical imaging provides the doctor with a number of diagnostic tools namely magnetic resonance imaging (MRI), X-ray and computed tomography (CT). MRI is a very versatile imaging modality, which is used to acquire images of different body parts such as brain, heart, knee etc. MRI is an important imaging technique for detecting abnormal changes in tissues and organs. Therefore, it has been widely used in the study of brain function, pathology and anatomy. Now most clinicians segment a specific area of brain MRI by manual segmentation method, which is time consuming and different between observers. The different tissues namely gray matter (GM), white matter (WM), and cerebrospinal fluid (CSF) other abnormal tissues are spread over the entire brain. It is not easy to separate them individually when a brain image is considered. So, an accurate brain MR image segmentation algorithm is essential in clinical application. Moreover, the brain tissue usually has the complex shape, boundaries and topology, which make accurate and robust segmentation of the brain tissue MR images difficult. Fuzzy C-means clustering (FCM) based algorithms are very popular, for FCM is good at solving the ambiguities and uncertainties in the image [1]. Fuzzy clustering using fuzzy C-means (FCM) algorithm proved to be superior over the other clustering approaches in terms of segmentation. But the major drawback of the FCM algorithm is the huge computational time required for convergence.

Basavaraj anami and prakash unki [2] have propose a two stage automatic method for brain MRI segmentation which contains MFCM clustering algorithm and level set method for normal brain MRI. The above work is performed on normal MRI brain image.

Spatial fuzzy C means (SFCM) and level sets segmentation based methodology is proposed in this project for automated brain MRI image segmentation and tumor detection. Brain tumor are one of the most common brain disease, so it is very important to improve the quality of medical image segmentation, because it could help to determine the lesion location for reducing the risk of surgery, surgical navigation and so on clustering approach is widely used in biomedical applications particularly for brain tumor detection in abnormal magnetic resonance (MRI) images.

II. LITERATURE REVIEW

A Basavaraj S. Anami et al [2] introduced combined method segmentation based methodology is proposed in this paper for automated brain MRI image segmentation. In this initial segmentation is done with by modified FCM which forms the first stage and the segmented result of first stage are used in second stage which comprises the level set based segmentation.

Kaihua Zhang et al [7] introduced a sliding window is used to transform the intensity domain to another domain, where the distribution overlap between different tissues is significantly suppressed. This paper presented a novel level set approach to simultaneous tissue segmentation and bias correction of Magnetic Resonance Imaging (MRI) images.

Wee-Chung Liew et al [3]In this paper An adaptive spatial fuzzy c-means clustering algorithm is presented in this paper for the segmentation of three dimensional magnetic resonance (MR) images.

Haili Zhang et al [6],In this paper, we present a multiphase segmentation model for MR images in the presence of strong intensity inhomogeneity. Masroor Ahmed and Mohammadet al [5] have described a method for automatic segmentation of brain tumor using brain MRI images. Image enhancement is done using Perona and Malik anisotropic diffusion method. Grouping tissues belonging to a specific group is done utilizing K-means clustering technique. A.Meena K.Raja et al [8] proposed a spatial fuzzy c means algorithm for the segmentation of PET image having brain neurodegenerative disorders. Mrs p. vijaylakshmi et al [7]proposed a brain magnetic resonance image segmentation which is done with k means clustering algorithm.

M. Shasidhar et al [4] A comprehensive feature vector space is used for the segmentation technique. Comparative analysis in

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terms of segmentation efficiency and convergence rate is performed between the conventional FCM and the modified FCM.
From the literature survey, it is observed that less work is done in the area of brain image segmentation and tumor detection.

III. METHODOLOGY

We have proposed segmentation of the brain MRI images for detection of tumors using clustering techniques. A cluster can be defined as a group of pixels where all the pixels in certain group defined by a similar relationship [1]. Clustering is also known as unsupervised classification technique. Here spatial fuzzy clustering algorithm for segmentation of the image by level set method is used for tumor detection from the brain MRI images. The stages of the proposed methodology are shown in the fig. 1.

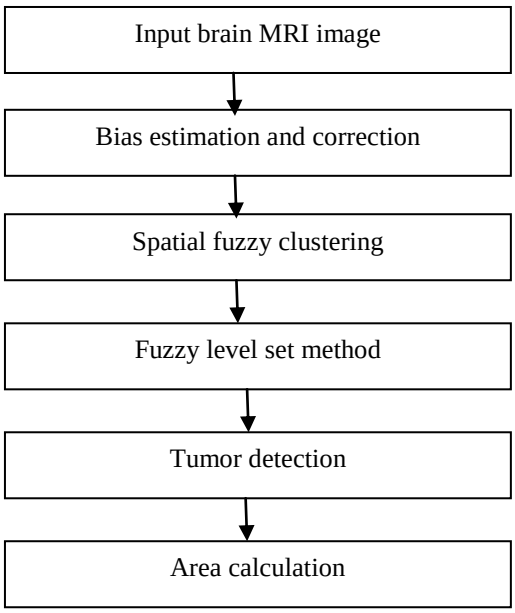

Fig.1. Stages of Tumour Detection

A. Bias estimation and correction

Segmentation of (clusters) an image in object classes and estimates the slow varying illumination artifact (bias field).The Fuzzy C-Means Algorithm for Bias Field estimation and correction of MRI Data.
Bias correction of image is done with subtraction of estimated image from original image. By this process noise is removed and the blurred portion is recovered. Fuzzy C-Means (FCM) clustering algorithm was originally introduced by Dunn and then it was modified by Bezdek.

B. Spatial fuzzy clustering

The bias corrected image input to spatial fuzzy clustering.
The spatial parameter combed with fuzzy means clustering is defined as:

$$h_{ij} = \sum_{k \epsilon w(x_j)} u_{ik}$$

Where w(xj) represents small square window function centered on pixel xj in spatial domain. The spatial function hij represents the probability that pixels xj belongs to ith cluster. When the majority of pixel neighborhood belongs to the same clusters, then the spatial function of a pixel for a cluster is large. Fuzzy C Means (FCM) clustering algorithm is incorporates the spatial neighborhood information with traditional FCM and updating the objective function of each cluster.

C. Level Set Segmentation

The fuzzy using pixel classification with level set methods utilizes dynamic variational boundaries for image segmentation. Segmenting images by means of active contours is well known approach instead of parametric characterization of active contours. Level set methods embed them into a time dependent PDE function. It is possible to approximate the evolution of active contours implicitly by tracking the zero level set.
The level set evolution of active contour implicitly tracking the zero level set Γ (t),

$$\phi\ t, x, y < 0\ x, y\ is\ inside\ \Gamma\ (t)$$
$$\phi\ t, x, y = 0\ x, y\ is\ at\ \Gamma\ (t)$$
$$\phi\ t, x, y > 0\ x, y\ is\ outside\ \Gamma\ (t)$$

D. Spatial fuzzy clustering with Level set method

Both fuzzy algorithms and level set methods are general-purposed computational model that can be applied to problems of any dimensions. A new fuzzy level set algorithm is proposed for automated medical image segmentation. The algorithm automates the initialization and parameter configuration of the level set segmentation, using Fuzzy clustering.
A new fuzzy level set algorithm automates the initialization and parameter configuration of the level set segmentation, using spatial fuzzy clustering. It employs a FCM with spatial constraints to determine the approximate contours of interest in a medical image. The objective function now is derived from spatial fuzzy clustering directly. The level set function will automatically slow down the evolution and will become totally dependent on the smoothing term.

E. Area calculation

The brain tumor occurs when there is the formation of abnormal cell within the brain. In this work binarization method is used to compute the area of brain tumor. It calculates the size of the tumor by calculating the number of white pixels (digit 0) in binary image.

IV. EXPERIMENT RESULT

The proposed algorithm and Fuzzy C-Means algorithm is implemented using MATLAB software and tested on the brain MRI images Firstly the input image is shown here, Fig 2 shows input images which has brain tumor.

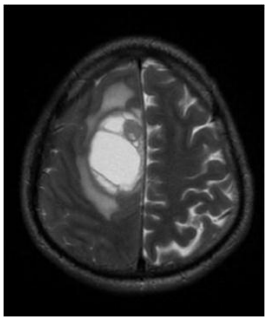

Fig.2. Input brain image

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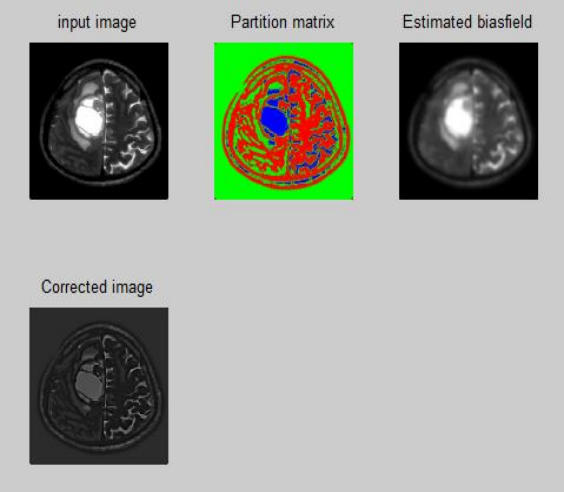

Fig.3. Bias field estimation and correction

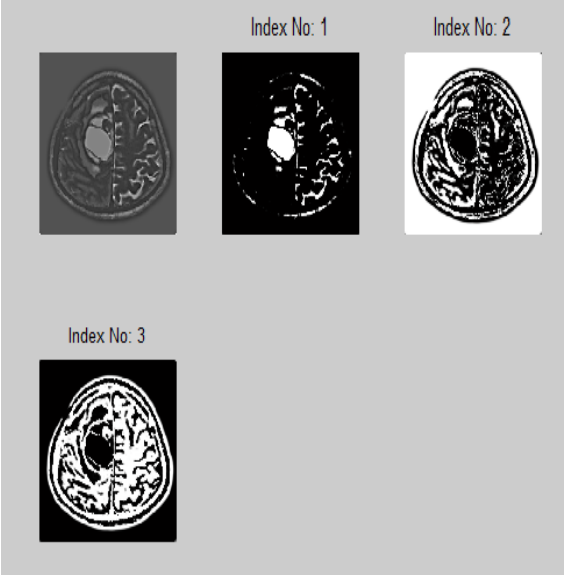

Fig.4. Spatial fuzzy clustering

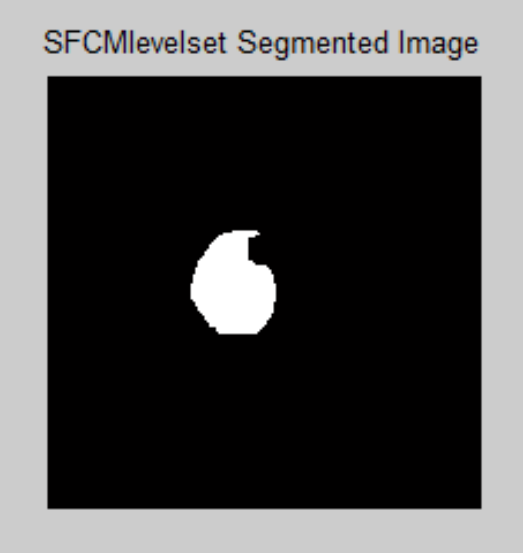

Fig.5. Spatial fuzzy clustering with Level set

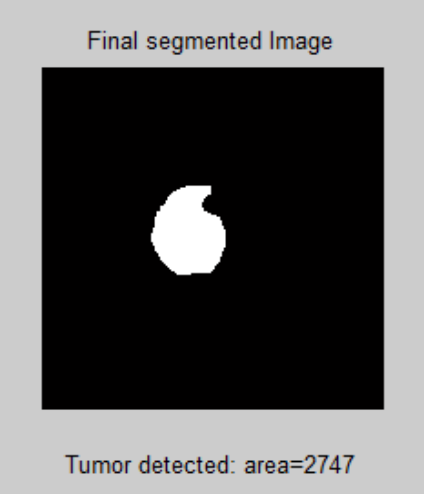

Fig.6. final segmented tumor detection output with area

V. CONCLUSION

In this paper we proposed spatial Fuzzy level set algorithm for automated MRI image segmentation. The proposed worked on image segmentation, tumor detection and area calculation which will help in clinical observations such as tumor stage detection. A spatial fuzzy clustering are the possibility of obtaining more homogeneous regions and less noise sensitivity. A level set segmentation by spatial fuzzy clustering for tumor detection of brain MR image. It is observed that the both method is able to segment the brain MRI for tumor detection. This automatic brain MRI image segmentation is useful in medical.

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