Fuzzy Corner Metric Based Tumor Segmentation using Outer Boundary Detection

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Abstract

The conventional fuzzy c-means (FCM) clustering is the most widely used unsupervised clustering method for brain tumor segmentation on magnetic resonance (MR) images.In this project, Present a novel efficient FCM algorithm to eliminate the drawback of conventional FCM. The proposed algorithm is formulated by incorporating distribution of the gray level information in the image and fuzzy corner metric to outer line detection.The conventional FCM and the proposed method are compared to explore the efficiency and accuracy of the proposed method.Region based fuzzy clustering is used for initial segmentation of tumor then result of this is used to provide initial contour for deformable model, which then determines the final contour for exact tumor boundary for final segmentation using gradient vector field as a external force field.

I. INTRODUCTION

Brain segmentation is an important task in medical image processing. Early diagnosis of brain tumors plays an important role in improving treatment possibilities and increases the survival rate of the patients. Manual segmentation of the brain tumors for cancer diagnosis, from large amount of MRI images generated in clinical routine, is a difficult and time consuming task. There is a need for automatic brain tumor image segmentation. The purpose of this paper is to provide a review of MRI-based brain tumor segmentation methods. Recently, automatic segmentation using deep learning methods proved popular since these methods achieve the state-of-the-art results and can address this problem better than other methods. Deep learning methods can also enable efficient processing and objective evaluation of the large amounts of MRI-based image data. There are number of existing review papers, focusing on traditional methods for MRI-based brain tumor image segmentation. Different than others, in this paper, we focus on the recent trend of deep learning methods in this field. First, an introduction to brain tumors and methods for brain tumor segmentation is given. Then, the state-of-the-art algorithms with a focus on recent trend of deep learning methods are discussed. Finally, an assessment of the current state is presented and future developments to standardize MRI-based brain tumor segmentation methods into daily clinical routine are addressed.

Quantitative analysis of brain tumors is critical for clinical decision making. While manual segmentation is tedious, time consuming and subjective, this task is at the same time very challenging to solve for automatic segmentation methods. In this paper we present our most recent effort on developing a robust segmentation algorithm in the form of a convolutional neural network. Our network architecture was inspired by the popular U-Net and has been carefully modified to maximize brain tumor segmentation performance. We use a dice loss function to cope with class imbalances and use extensive data augmentation to successfully prevent overfitting. Our method beats the current state of the art on BraTS 2015, is one of the leading methods on the BraTS 2017 validation set (dice scores of 0.896, 0.797 and 0.732 for whole tumor, tumor core and enhancing tumor, respectively) and achieves very good Dice scores on the test set (0.858 for whole, 0.775 for core and 0.647 for enhancing tumor). We furthermore take part in the survival prediction subchallenge by training an ensemble of a random forest regressor and multilayer perceptrons on shape features describing the tumor subregions.

Combining image segmentation based on statistical classification with a geometric prior has been shown to significantly increase robustness and reproducibility. Using a probabilistic geometric model of sought structures and image registration serves both initialization of probability density functions and definition of spatial constraints. A strong spatial prior, however, prevents segmentation of structures that are not part of the model. In practical applications, we encounter either the presentation of new objects that cannot be modeled with a spatial prior or regional intensity changes of existing structures not explained by the model. Our driving application is the segmentation of brain tissue and tumors from three-dimensional magnetic resonance imaging (MRI). Our goal is a high-quality segmentation of healthy tissue and a precise delineation of tumor boundaries.

II. RELATED WORK

N.Moon ; E. Bullitt ; K. van Leemput ; G. Gerig presents the Combining image segmentation based on statistical classification with a geometric prior has been shown to significantly increase robustness and reproducibility.

Haocheng Shen ; Jianguo Zhang presents the Grid conditional random fields (CRFs) are widely applied in both natural and medical image segmentation tasks. However, they only consider the label coherence in neighborhood pixels or regions, which limits their ability to model long-range connections within the image and generally results in excessive smoothing of tumor boundaries.

M. Usman Akram ; Anam Usman presents the Magnetic resonance (MR) images are a very useful tool to detect the tumor growth in brain but precise brain image segmentation is a difficult and time consuming process.

V. Zeljkovic ; C proposed the The MRI or CT scan images are primary follow up diagnostic tools when a neurologic exam indicates a possibility of a primary or metastatic brain tumor existence.

PatilAbhishekUday , proposed the The problem that frequently occur in the practical processing of medical images consists in the lack of machines for the evaluation of images.

Ishita Maiti ; Monisha Chakrabor proposed In this work a new method for brain tumor detection is developed. For this purpose watershed method is used in combination with edge detection operation.

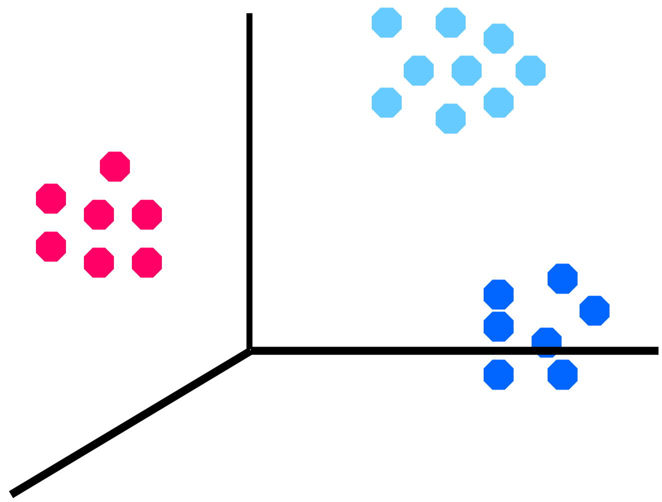
Nidhi Singh proposed the Brain tumour is known to be the major setback which counts as the major fatality cause for human beings.

K. Bhima ; A. Jagan proposed the the remarkable growth in image processing for discussing medical imaging is one of the emerging field and the requirements for advancements in medical imaging is always emergent and challenging.

III. EXISTING SYSTEM

Image Segmentation by Clustering. It is a classification technique. Given a vector of N measurements describing each pixel or group of pixels (i.e., region) in an image, a similarity of the measurement vectors and therefore their clustering in the N-dimensional measurement space implies similarity of the corresponding pixels or pixel groups. Therefore, clustering in measurement space may be an indicator of similarity of image regions, and may be used for segmentation purposes.

The vector of measurements describes some useful image feature and thus is also known as a feature vector. Similarity between image regions or pixels implies clustering (small separation distances) in the feature space. Clustering methods were some of the earliest data segmentation techniques to be developed.



Similar data points grouped together into clusters.

Most popular clustering algorithms suffer from two major drawbacksFirst, the number of clusters is predefined, which makes them inadequate for batch processing of huge image databases

Secondly, the clusters are represented by their centroid and built using an Euclidean distance therefore inducing generally an hyperspheric cluster shape, which makes them unable to capture the real structure of the data.

This is especially true in the case of color clustering where clusters are arbitrarily shaped

IV. CLUSTERING ALGORITHMS:

K-Means Clustering Overview

K-Means clustering generates a specific number of disjoint, flat (non-hierarchical) clusters. It is well suited to generating globular clusters. The K-Means method is numerical, unsupervised, non-deterministic and iterative.

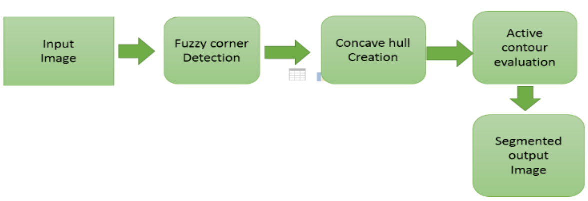
IV. PROPOSED SYSTEM

The work presents a methodology for automatic contour initialization in ACM and demonstrates the applicability of the method for medical image segmentation from brain images

A fuzzified corner metric, based on image intensity, is proposed to identify the feature markers to been closed by the contour. A concave hull based on α shape, is constructed using these fuzzy corners to give the initial contour.Corners are feature points in an image that are identified by presence of large variation in intensity around a pixel in all directions. One of the well known corner detectors is Harris corner and edge detection method .

The corners are detected using the Eigenvalue distribution obtained from a corner response metric

Figure proposed system



Corner detection

Detect the traditional Harris corners in parent image using cornerness measure RðxÞ Modify the corner metric using the fuzzy approach Output the fuzzycorners C(x)

Matlab implementation results

Proposed work coded in Matlab. corresponding fuzzy corner outputs and tumor segmented outputs shown in fig

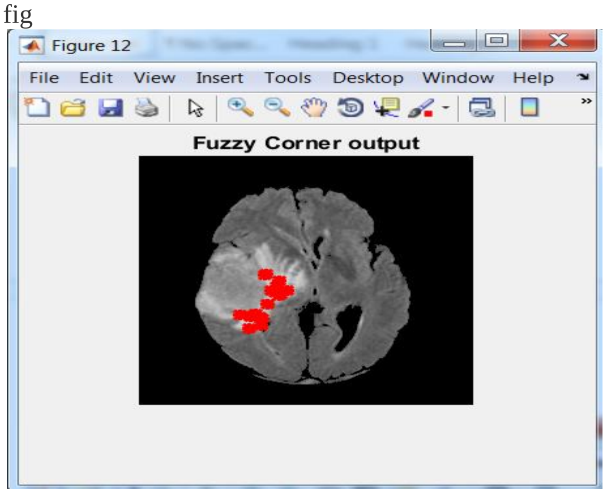


Figure fuzzy corner outputs

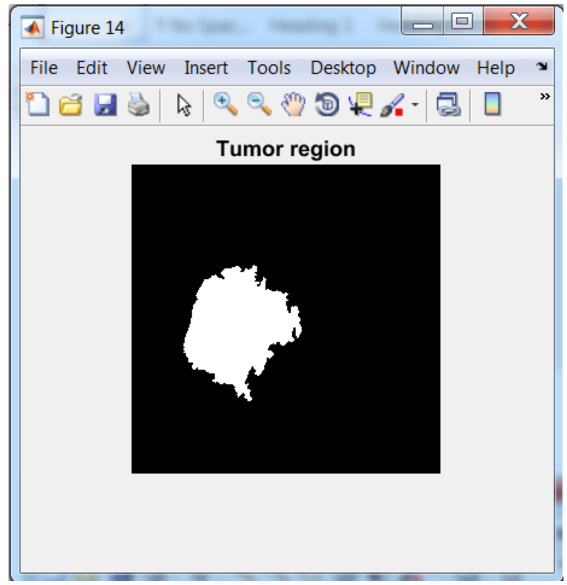


Figure segmented outputs

V. CONCLUSION

Segmenting regions from medical images is an involved process for various reasons. Deformable contours provide an almost accurate dissection of ROI from background owing to their ability to constrict or expand upon external constraints. There liability of such segmentation can only be guaranteed if the initial contour is close enough to the interest segment. To ensure good results, manual setting has so far been the only viable option which increases the fatigue of clinical users. To facilitate as smooth and less intensive segmentation, a novel method of automatic contour initialization for ACM is presented in this study. The proposed method uses a fuzzified corner metric based on image intensity to identify the feature markers enclosed by the contour. A concave shape approximating the boundary of these fuzzy corner points is obtained using α hull to give the initial contour for the ACM. The additional computational cost is one order less than the cost of ACM evolution. The proposed technique is form robustly even in the presence of noise

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