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Segmentation Of The Coronary Artery Region In The Cardiac Mri Images Using Fuzzy C-Means Model

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Abstract: Image segmentation plays an important role in computer vision and image analysis. The segmentation results can be used to identify regions of interest and objects in the scene. That too, in the field of medical imagery, cardiac is the most complex organ in the human body and is susceptible to various pathologies. Cardiac magnetic resonance (CMR) is a widely accepted imaging modality for detecting a disease of cardiac structures images which is prone to noise, varying anatomical structures, on-homogeneity, volumetric data and sometimes deviation. So, the accurate segmentation of cardiac structures and substructures is a very tedious task. The fuzzy c-means (FCM) algorithm is one of the most used techniques for image segmentation. The accuracy of FCM is due to the employment of fuzziness for the clustering of each image pixel. In this project, we present a new approach of Magnetic Resonance Imaging (MRI) for cardiac images known as tissue segmentation, which consists of three main phases: (1) Noise removal using median filter, (2) Clustering based on the FCM, and (3) Segmentation using the fuzzy level set method. The results depict that the segmentation accuracy is 85% when tested on 50 samples of MRI cardiac image dataset.

Keywords- Clustering Image Segmentation Technique, Medical Image Segmentation, Fuzzy C means algorithm, Marker based Segmentation Technique.

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I. INTRODUCTION

The fundamental objective in segmentation process is to segment an image into regions that are homogeneous in nature regarding at least one attributes. Segmentation is a vital device in restorative image processing and it has been helpful in numerous applications, for example, discovery of tumors, recognition of the coronary outskirt, careful arranging, estimating tumor volume and its volumetric reaction to treatment, grouping of platelets, identification of small scale calcifications on mammograms, heart image extraction from cardiovascular cine angiograms, and so forth. In a few applications, it might be helpful to arrange image pixels into regions, for example, bones, muscles and veins, while in others into regions, for example, disease, tissue disfigurements and various sclerosis injuries. As of late, numerous algorithms have been proposed for cerebrum MRI segmentation. The most prominent techniques are thresholding, district developing and clustering. The full robotized power based algorithms have high affectability to different clamor curios, for example, intra-tissue commotion and between tissue force differentiate decrease. Clustering is most mainstream approach for segmentation of mind MR images and normally performs superior to alternate strategies. Clustering is a standout amongst the most valuable errands in information digging process for finding gatherings and distinguishing fascinating dispersions and examples in the fundamental information. Clustering issue is tied in with separating or apportioning a given informational index into gatherings (groups) to such an extent that the information focuses in a bunch are more like each other than focuses in various groups. For instance, consider a retail database records containing things acquired by clients. A clustering methodology assemble the clients so that clients with comparable purchasing behaviors are in a similar group. Consequently, the primary worry in the clustering process is to uncover the association of examples into ―sensible‖ gatherings, which permits finding similitudes and contrasts, and in addition enabling us to determine valuable decisions about them. This thought of clustering is appropriate in numerous fields, for example, life sciences, medicinal sciences and designing. Clustering might be found under various names in various settings, for example, unsupervised learning (in example acknowledgment), numerical scientific classification (in science, nature), typology (in sociologies) and parcel (in chart hypothesis). In the clustering process, there are no predefined classes and no precedents that would demonstrate what sort of attractive relations ought to be legitimate among the information that is the reason it is seen as an unsupervised process. Then again, grouping is a method of appointing an information thing to a predefined set of classifications. Clustering produces introductory classifications in which

estimations of an informational index are ordered amid the arrangement process. Restorative images assume imperative job to get to patients for analysis and treatment. Image segmentation is the initial step and the most basic undertakings of image examination. Its goal is that of separating from an image by means of image segmentation. The computerization of therapeutic image segmentation has discovered wide application in various territories, for example, conclusion, treatment arranging, and PC coordinated medical procedure. Regardless of whether PC supported tumor recognition is been considered for most recent two decades, understanding of MRI image is as yet a troublesome undertaking. Translation of this image is extremely delicate and numerous radiologists survey is required for lessening likelihood of misdiagnosis. In this paper, clustering calculation, for example, Fuzzy C Mean (FCM) is actualized to extricate the suspicious locale in MRI image.

II. RELATED WORK

Clustering is a strategy for gathering an arrangement of examples into various bunches with the end goal that comparative examples are doled out to one group. Each example can be spoken to by a vector having numerous characteristics. Clustering method depends on the calculation of a proportion of likeness or separation between the particular examples. A group is a gathering of articles which are comparable among them and are not at all like the items having a place with different bunches. In contrast to order, in which objects are doled out to predefined classes, clustering does not have any predefined classes. The fundamental favorable position of clustering is that fascinating examples and structures can be found straightforwardly from huge informational collections with little or none of the foundation learning. The bunch results are emotional and usage subordinate. K-implies clustering is a basic clustering strategy with low computational intricacy. The groups delivered by K implies clustering don't cover. The Fuzzy C-implies clustering calculation is a delicate segmentation strategy that has been utilized widely for segmentation of restorative images. In this work, we utilize K-implies clustering and Fuzzy C-implies Clustering techniques only to deliver a segmentation of the image. In this exploration paper we executed shading clustering calculation, Fuzzy C Means clustering and marker controlled watershed segmentation calculation independently for medicinal image segmentation. The Clustering algorithms are unsupervised learning algorithms, while the marker controlled watershed segmentation calculation makes utilization of computerized thresholding on the slope size guide and post-segmentation converging on the underlying parcels to lessen the quantity of false edges and over-segmentation. Segmentation has wide application in medicinal field [5]. Having great segmentations will encourage clinicians and patients as they give fundamental data to 3-D perception, careful arranging and early illness acknowledgment. Magnifying lens image segments indicate extraordinary changeability of shapes, sizes, forces and surfaces [6]. In addition, amid obtaining, it is important to set up a high number of parameters that outcome within the sight of clamor, non-homogeneous light, fluffy shapes and low differentiation. This trademark results in a wrong segmentation while applying traditional segmentation techniques. Watershed Transform (WT) is an incredible morphological device to section surface images into regions of intrigue. This change is versatile to various kinds of images and equipped for recognizing to a great degree complex articles. The WT is a segmentation technique dependent on regions, which orders pixels as per their spatial vicinity, the inclination of their dark dimensions and the homogeneity of their surfaces. To keep away from over segmentation a solitary marker for each protest of intrigue must be chosen [7].The determination of satisfactory markers on these sorts of images is an excruciating and in some cases vain errand. Subsequently, the accomplished onlooker characterizes markers semiautomatically. The programmed assurance of markers is as yet a troublesome objective to accomplish. The present assurance algorithms are exceedingly subject to the structure to be sectioned. Additionally, they have a high computational expense and they decide markers in a successful yet not programmed way when processing images.

III. PROPOSED SYSTEM

The main aim of this dissertation is to implement fuzzy C-means algorithm to segment the brain MRI cardiac pathologies using level set to obtain the best results, which implies pictures clear of noise and spots, until we can derive obvious images that doctors can easily recognize. This dissertation intends to complete these objectives:

Study and apply an appropriate technique to remove Gaussian noise in medical images.

To cluster MRI cardiac pathologies before segmentation takes place.

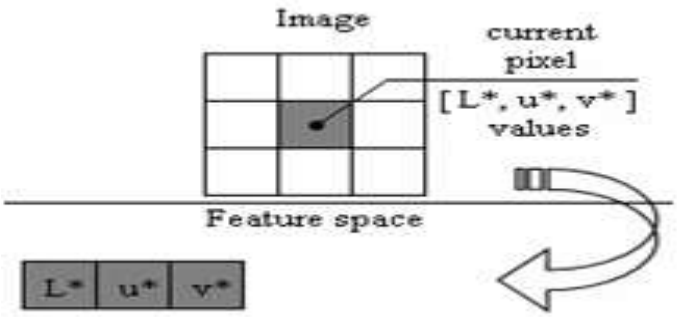
To segment clusters of MRI cardiac pathologies by using level set algorithm

The model gives nearly 85 percent the training accuracy on cardiac coronary artery dataset. The following results are obtained while run the prediction process.

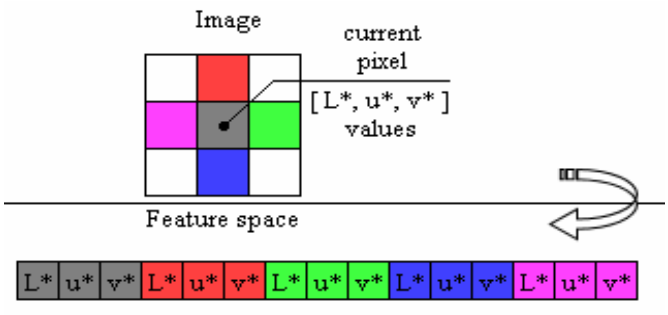
Fuzzy C-Means Segmentation

Segmentation process consists of several steps. The first of all is input image conversion to chosen feature space, which may depends of used clustering method. In our case is input image converted from RGB

color space to L*u*v* color space and L*, u* and v* values are features respectively attributes for fuzzy c-means clustering method. Next step after input image conversion to feature space is applied clustering. In our case, we have chosen fuzzy c-means clustering method, settings are in experiments section.
After these two steps (input image conversion to feature space of clustering method and accomplishing clustering method) is accomplished next segmentation method.
Method 1 (M1) BEGIN OF M1
Assumptions: Image transformed into feature space, number of clusters c , stop condition , fuzziness parameter m .
Step 1: Cluster image in feature space, with next conditions: number of clusters is c , fuzziness index is m and stop condition is .
Step 2: Repeat for each pixel aij of image I .
Step 2.1: Find out, into which cluster CA belongs pixel aij at most.
Step 2.2: Find out, whether in the closest surroundings of pixel exists segment Rk, which points belong to same cluster CA
Step 2.3: If such segment Rk exists, than pixel aij add to segment Rk ,
else create new segment Rn and add pixel aij to new segment Rn . Step 3: Merge all segments, which belong to one cluster and are neighbors.
Step 4: Arrange borders of all segments.
END OF M1
Segmentation method used in experiments is based on simple region growing method. Method was used in [2, 4, 6] and in this paper is marked as method M1. In [2] was used with simple defuzzification rule, in [4] was this method enhanced with thresholding parameter T and in [6] was used with another defuzzification rule.
Method M2 is segmentation method based on method M1, but method M2 uses extended feature space, which will be described in next section. Difference between method M1 and M2 will be only feature space.
The most important part of this segmentation method is extension of feature space. Extension of feature space is based on simple idea, that neighboring pixels have approximately same values of lightness and Chroma. But in real images, noise is corrupting the image data or image usually consists of textured segments. Basic segmentation methods based on fuzzy c-means clustering are working as follows:
Convert image into feature space of clustering method (usually is used RGB color space, but IHS, HLS, L*u*v* or L*a*b* color spaces are used too).
Run fuzzy c-means method on converted image.
Use some defuzzification rule or rules to classify each pixel to segment. Simple defuzzification rule is based on maximal membership grade of pixel to cluster [1, 4].



Basic feature space is only color space, e.g. RGB, HIS, HLS or L*u*v* color spaces as shown below.
This feature spaces in combination with clustering methods have one big disadvantage. In clustering process is not involved information about pixels in neighborhood, which results in bad segmentation
results because of noise or texture. Standard feature space
Extension of feature space is based on involving of neighboring pixels' information. One pixel has 15 instead of 3 features. In simple case [2, 4, 6] has pixel only 3 features (L*u*v* values, Figure 1). In our modification has pixel 15 features, its own L*u*v* values and L*u*v* values of its neighbors. In practical implementation of this extension was used next sequence of pixels: Current pixel, up, right, down and left neighbor pixel as shown below.



Extended feature space

Simulation Results

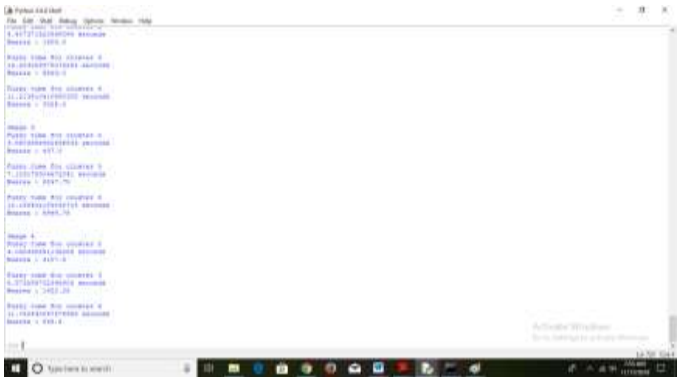


Fig.1 Training result

According to the segmentation fuzzy c mean for each image clustering will be different no. of iteration might be increase or decrease when we training the dataset images for every image the accuracy will be changed the segmentation area will also change according to the overall accuracy training is 85 %.

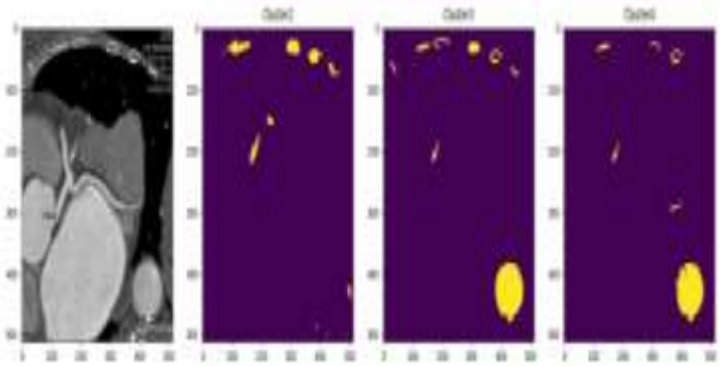


Fig.2 Training Image

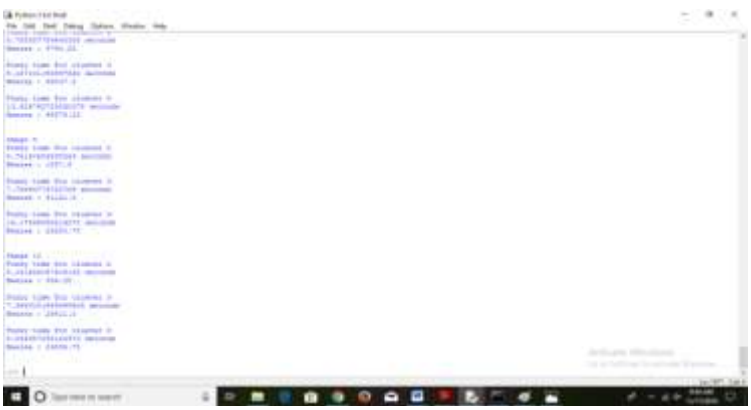


Fig.3 Test result

Same will happen in case of testing .the fuzzy c mean for each image clustering will be different no. of iteration might be increase or decrease when we testing the images for every image the accuracy will be changed the segmentation area will also change according to the overall accuracy testing is 68 %.

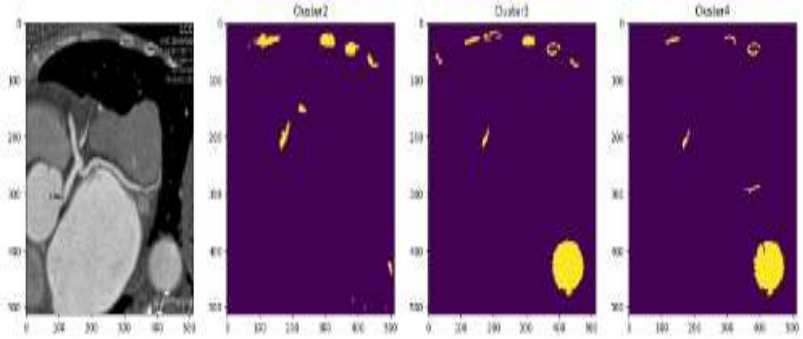


Fig4.test image segmentation

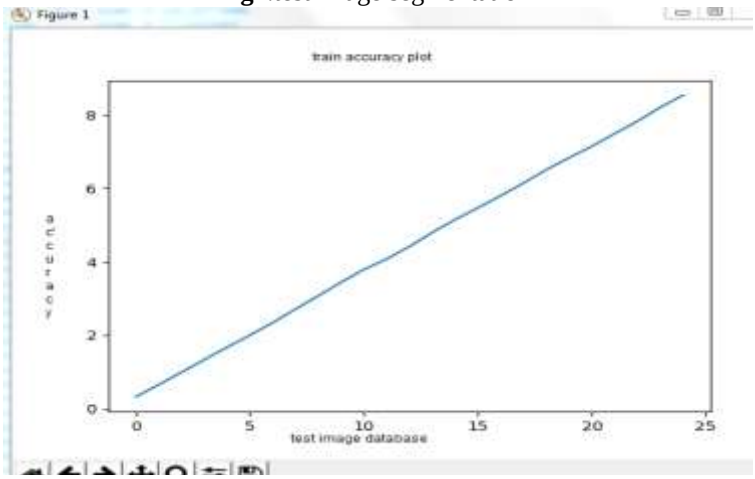


Fig5.train accuracy graph

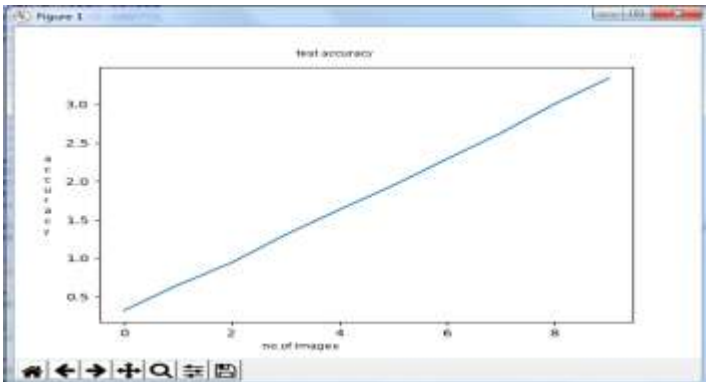


Fig6.test accuracy graph

IV. CONCLUSION & FUTURE SCOPE

Method M1 creates big number of segments, which is apparent from results. Method M2 creates much less number of segments. Extension of feature space of fuzzy c-means clustering method brings better segmentation results. This extension filters noise of one pixel's size. Cluster center in our case is typical pixel of segment with its typical neighbors (up, right, down and left neighbor). Method M2 has good segmentation results in case of images with large homogeneous segments, images can be corrupted with one pixel's noise.

But one of demands wasn't reached in experiments. It concerns demand on borders of segment. Border of segment may be simple and may not be rugged. For simplifying, respectively smoothing of segments' borders, may be used another methods, e.g. active contours. However simplifying borders wasn't objective of this work, but it grants impulses for next research.

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