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A Comparative Analytical Study On Clustering Algorithms Supported For Effective Liver Segmentation

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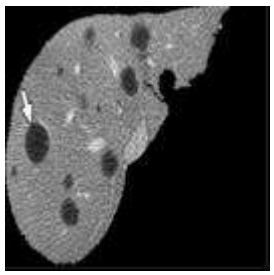
Abstract: ***Clustering, an unsupervised learning technique plays a vital role in Medical Image Segmentation. Our research is segmenting liver images with tumour. Clustering algorithms are used to segment the liver tumor images. Cluster Analysis is an important concept of analyzing different liver tumor images by grouping data objects which are related to each other and unrelated to the data objects of another group. There are different types of clustering algorithms available to segment Liver. In this paper we focus on two important clustering algorithms namely Fuzzy C-Means(FCM) and Spacial Fuzzy C-Means(SFCM). A comparative study is done which brings down curtain that SFCM yields better detected tumor image with time complexity compared to FCM.***

Keywords- ***Image Segmentation,Liver Image,Clustering,Time complexity,Fuzzy C-means,Spacial Fuzzy C-means,Unsupervised learning***

I. INTRODUCTION

Liver is the largest solid internal organ present in human body. It is an essential organ which is responsible for several complex chemical actions that takes part inside which the body needs to survive. Tumour is a swelling part that has an abnormal growth of tissues which may be benign or malignant. Analysis of these Liver Tumour CT images plays a major role in today's medical environment and it is a challenging technique due to the classification of tumour cells.



(Fig 1: CT Liver image with tumour cells)

We have choosen clustering segmentation technique which is the technique of splitting the digitized CT image into several segments. It is a classification technique. Segments are collections of pixel sets[2]. Image segmentation is extraction of features from the original images which is required for our research purpose. Image segmentation mainly used for splitting regions of inward and outward boundaries in images[1].

II. DIGITAL IMAGES

A digital image is mostly a two dimensional array of square regions generally known as pixels[2]. Digital images are of various categories namely Binary image, Gray scale image and Color image. For each pixel, Binary image has only two values either 0 or 1. Gray scale image has an array of 0 to 255 values representing all shades of gray. Color images has a combination of RGB color models. Using image processing techniques, the CT images are converted to digital images and undergoes some process for the sake of extracting informative data from it.

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(Fig 2: Segmented CT Liver Tumour image)

Digital image segmentation and its algorithms are essential in many medical imaging applications for determination of mass volume of tissues[3] and diagnosis of disease level[4],
There are many image segmentation algorithms available. Among them, fuzzy clustering is more attractive, due to its robustness and time consuming[6].

III. FUZZY C-MEANS(FCM) CLUSTERING IN LIVER TUMOUR

Fuzzy C-Means is an unsupervised clustering technique with an up gradation of K-means clustering algorithm which makes the input image easier to analyze. It is an iterative process and stops when the number of iteration is reached. A comparison of two consecutive values of the objective function is done. The object selected is not only a component of one cluster rather than many clusters[13]. When the difference between the two values are less than the predefined value, then also the process stops. The boundaries of the image are between 0 and 1. Fuzzy C-means plays an important role for ambiguous data[10]. The distance between each data points are calculated and classified into multiple classes.

Steps in FCM:

Let D = {d1,d2,d3 ...,dn} be the set of data points and V = {v1, v2, v3 ..., vc} be the set of centers.
Step 1: Select 'c' cluster center on random basis
Step 2:Calculate the membership function
Step 3:Compute the fuzzy centers
Step 4:Repeat steps (2) and (3) until minimum value of objective function is achieved

Advantages of FCM:

Easy accessing and implementation of overlapping data sets

Minimizes the cost function

Data point belongs to more than one cluster center

Disadvantages of FCM:

Long computational time

Sensitivity to the initial guess (speed, local minima)

Impact of noise is more(sensitivity to noise)

One expects low (or even no) membership degree for outliers (noisy points)

IV. SPATIAL FUZZY C-MEANS CLUSTERING(SFCM) IN LIVER TUMOUR

Spatial Fuzzy C-means clustering is an additional spatial information fused to the membership function of Fuzzy C-means clustering algorithm. The spatial information is important in clustering, but it is not utilized in a standard FCM algorithm[14].It usually involves optimizing an objective function. The purpose of this additional information is that the standard FCM is not so effective in removal of noise in CT images. This spatial information finely tunes the liver tumour images irrespective of noise.

Steps in SFCM:

Spatial FCM involves two passes.
Step 1: Membership function is calculated.
Step 2: The membership information of each pixel is mapped to the spatial domain
Step 3: The spatial function of each nearest pixel is computed
Step 4: Next iteration procedure continues when the difference between two consecutive iteration of cluster is same
Step 5: Relocated to each pixel according to cluster when membership function is calculated maximum

Advantages of SFCM:

- Eliminates noisy spots between pixel
- Reduces false blobs between initial pixel
- Not robust to noise
- More homogeneous regions pixel are obtained

V. RELATED WORK

Sajith A.G ,Hariharan S[7],2015 described that FCM technique without spatial information in its membership function is very sensitive to noise ,but does not predict noise completely.

A.J.Patil,CS Patil,R.R.Karhe,M.A.Aher [8] discovered that FCM algorithm is faster but time complexity is more than K.means algorithm.

Weiling cai, Songcan chen ,Daoqiang zhang[9] depicted that FCM algorithm with spatial constraint is very effective for image segmentation.

R.Poongodi [5] surveyed that fuzzy clustering has best performances using level set evolution.

Hamed ShamSi , Hadi seyedarabi[11] proposed a new modified FCM algorithm which performs to more robust to noise than FCM algorithm.

D.Selvathi, S.Priyadarshini[12] framed that spatial FCM algorithm proves to be efficient and less time consumption and makes computation feasible.

B.Vinodhini[6] surveyed the types of clustering algorithms and concluded that the effectiveness of the clustering algorithms are very high when dealt with weighted fuzzy factor.

S.Kumaravel, N.S.Vijayalaksmi, Abdul Rahiman[10] discovered that test image features are simulated with trained classifier for making decision of liver tumour stages like benign and malignant(cancer).

VI. CONCLUSION

A Digital Image taken for research issue is not completely clear from noise. It may hold different kinds of noises. To remove the speckles from the image, Fuzzy clustering is a major technique in the area of image processing. In this paper we have compared the most two important fuzzy clustering algorithms for their computing performance and clustering accuracy. After doing survey of various algorithms, We can make a conclusion that FCM technique incorporated with spatial information is very effective for segmentation of liver tumour images and less sensitive to noise with less time complexity and greater accuracy.

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