Literature Review on Image Segmentation Using Support Vector Machine and Fuzzy C-Means Clustering

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Abstract- Image segmentation partitions an image into modules, with higher correlation surrounded by objects contained during the image segmentation. At present, several techniques are used to segment the images in the Segmentation field. A challenging concern is still segmenting the images in an expert manner. A set of objects considers into groups is known as clusters and it is a task of assign image process. The clustering algorithms are considered with two classifications; there are soft (fuzzy) clustering and hard clustering. The fuzzy c-means (FCM) algorithm is the most popular algorithm in the field of image segmentation due to its less sensitivity to noise and simplicity and it is broadly used in the field of engineering disciplines. A literature review represents the most recent image segmentation techniques using fuzzy clustering.

Keywords- Image Segmentation, Support vector machine, Fuzzy C-means clustering, clustering algorithms

I. INTRODUCTION

Image segmentation is partitioned an image into set of disjoint regions that are homogeneous and visually different with respective characteristics in computer vision for accomplishing high-level considerations from digital images. Digital image processing is termed as processing image information by using PC to assure the application requirements or the human visual psychology. To consider several factors were to segment the images like continuity in pattern, proximity, similarity of patterns, and parallelism, closure and familiarity the same as base parameter for performing image analysis technique. In the intelligence of an already fixed criterion is to split the image by homogeneous regions and it takes the benefit of the segmentation. Several segmentation criteria pre-exist as following the type of processed images, the criterion will take into account the gray level, texture, movement, color or even the distance. An algorithmic perspective of the segmentation is to allocate to each pixel of the image a label considering to a specify region. In this classification of image pixels know how to be performed in unsupervised mode or supervised mode. Image segmentation approaches were splitted into four types: they are clustering, thresholding, region extraction and edge detection [1].

These categories are differentiated into the essential concepts: Contour-oriented, color oriented, model oriented, region-oriented, pixel oriented, and hybrid as given below explanation of these categories.

- In the thresholding algorithms does not split those regions using the same gray level but do not belong with the same region. Additionally, they cannot process images whose histograms are nearly unimodal, particularly if the target region is much less than the background region.
- Region extraction algorithms cope with spatial repartition of the image information to perform better than the thresholding approaches intended for many sets of images. The regions generated both based on the order in which pixels are scanned on the value of pixels that are first scanned and gathered to describe each new segment.
- The edge detection technique is one of the most popular used approaches to the difficulty of image segmentation and it is based on the detection of points with abrupt modification at gray levels. The drawback of the edge detection techniques does not easily recognize a closed curve or boundary and also it does not work well if images contain many edges.
- In this Clustering method analyzing an image at the same time as a set of multi-dimensional data. It classifies the image into various parts with certain homogeneity criterion, so that it can obtain better results of segmentation process. On the other hand, the over-segmentation is the issue that should be feature extraction, which is a significant aspect for performing clustering technique [2].

Several various segmentation methods are enhanced with segmentation process and detailed reviews can be found [6]. Because the bottleneck of the development of image processing technology manages until now there is no a technique can manage the entire segmentations of different kinds of image.
SVM identifies and assists to check whether if the image is detected or not detected. Support vector machine (SVM) is considered as a supervised machine learning algorithm and that it has typically utilized for performing pattern identification from the time if it is introduced in year 1990s [3, 5]. SVM is considered as a classification technique and it categorizes pixels into one-class, two or more classes. The benefits of SVM are more suitable to segment images in an executive manner and SVMs consider a very useful algorithm like face detection, face recognition, speech recognition and image recognition. The focal idea of the SVMs is building an optimal hyper plane with the intention of classification of linearly separable patterns. It assists in determining the difference in two classes by making a Hyper-plane and therefore segregates the classes. The classification through SVM is easier when it is a linear plane, it adds feature to solve the problem. SVM pixel classification holds useful application in the field of concept based image retrieval, machine vision, medical imaging and object detection.

The Fuzzy C-means clustering (FCM) is an unsupervised algorithm with self-adaptive manner and fast convergence [4]. By the usage of FCM to divide the image, the uncertain information in the image knows how to be partition and obtain better segmentation. In the image segmentation process, many clustering techniques are applied including fuzzy clustering that has been developed due to the theory of fuzzy sets. A cluster is defined as a set of objects and it types such as Fuzzy c- means, K-means, Mixture of Gaussian, and Hierarchy method. To Compare the traditional image segmentation algorithm, the FCM image segmentation algorithm know how to solve the issues of traditional segmentation algorithm and the threshold to keep away from partition because of threshold selection inappropriate contact; the FCM image segmentation algorithm does not require to identify that the image grayscale data of first and second order derivative information to avoid from difficult mathematical seeking problem. The main objective of a color image segmentation using support vector machine (SVM) classification research is to provide a better segmentation result compare to other techniques. Based on that work firstly, the pixel level color and texture features of the image are extracted and they are used as input to the SVM classifier. The Gabor Filter and homogeneity model performs through extracting these features. The advantage of the image segmentation handles both the pixel level information of the image and as well the capability of the SVM Classifier.

II. LITERATURE REVIEW

2018, Subhrajit Barui, et al. [7] introduced the SVM pixel classification process on color image segmentation is highlighted and handles helpful application in the field of concept depends upon object detection, medical imaging, machine vision and image retrieval. The image segmentation process is achieved one by one step. Initially this process get start to know the type of the texture and color were used as an input to the SVM classifier. These inputs are extracted using local spatial likeness measure model and Steerable filter also known as Gabon Filter. After that, it is qualified by using Fuzzy C-Means (FCM). Both the pixel level information of the image and as well the capability of the SVM Classifier experiences some sophisticated algorithm to figure the final image. The images are segmented and if any one of them is not classified, the training process requires to be replicated again so as to match the desired result. The result is compared with one another and the process provides much faster and better result to compare than the other proposed techniques.

2018, C. Latha, et al. [8] researched Fitness function in Genetic Algorithm (GA) based Fuzzy C-Means clump, and Morphological operation is to extract tumor from MRI. The new FCMFF in Genetic Algorithm (GA) is performed on some images moreover to experiment results of recital are compared along by means of analysis of the ground truth image. The performance of Fuzzy c-means, Probability-based Fuzzy C-Means, Threshold-based Fuzzy C-Means segmentation and FCMFF in GA The accuracy, MAE, Dice overlap, JI,JD,MSE,RMSE,PSNR,BDE of various segmentation techniques are reported. The FCMFF in GA segmentation gives a better result on considering the whole performance.

2018, N. Harini, et al. [9] proposed FCM that it plays most important role in maintaining and de-noising detail information is to decrease noise effects in the process of image segmentation. Haar Wavelet Transform (HWT) is utilized for handling discrete image transforms and processing. The proposed system uses a parameter which tradeoffs the noise sensitivity and preserving the information of the image in an effective manner. On the other hand, exact limits of the regions were obtained; every empirical dispersion of the image is computed by FCM segmentation. A classification process depends upon the Support Vector Machine (SVM) classifier to is distinguish the abnormal tissue and the normal tissue.

2017, Dongling Liu, et al. [10] proposed fuzzy c-means algorithm is improved to utilize in brain MR image segmentation. The proposed algorithm has better edge characteristic. In order to test the performance of proposed scheme, brain MR image of 128 X 128 pixels are used in the experiment. The grayscale ranges between from 0 to 255. FCM and improved FCM algorithm take gray level as characteristic. The enhanced fuzzy c-means and fuzzy c-means algorithms are compared in this research.

2017, J. Kowski Rajan, et al. [11] researched a color image segmentation using SVM pixel classification. The benefit of the image segmentation performs both the pixel level information of the image and moreover the capability of the SVM Classifier. The negative aspects of the proposed image segmentation are that it lacks sufficient robustness to noise. The proposed algorithm is signified by
using the Berkeley segmentation database and that accomplishes improved quantitative results than the segmentation methods.

2017, G.Ravindran, et al. [12] analyzed and compared the gray level texture feature techniques, Fuzzy C means, number of clusters, and to discover that algorithmic scheme provides enhanced outcomes in the image segmentation. The proposed image clustering technique is validated and verified in MATLAB software and compared the features with conventional clustering techniques. Initial step to convert the grey after that discover the cluster depending on number of cluster to examine the mean cluster value. The five parameters are used like Correlation, Contrast, Energy, Entropy and Homogeneity are found by using GCLM technique. By using Fuzzy C means and K means evaluate the cluster mean value from the each cluster, in the same way alter the number of clusters to discover the cluster mean from each cluster. Comparison between the segmentation techniques like K means and the Gray Level Co-occurrence Matrix (GLCM), K means give the most excellent aspects of texture feature. Also, comparison between the FCM C Means and K means clustering algorithm; FCM gives the more accuracy values.

2016, Min Li, et al. [13] proposed and intended for segmentation of brain MRI data with the support of an improved algorithm based on FCM clustering. In this case study, the MRI data used to provide by the Third Military Medical University and the image matrix was 512 pixels x 512 pixels. To evaluate the performance of the enhanced FCM technique, our segmentation results are compared with those produced using the conventional FCM algorithms and the EM technique. Here, this research explained the comparison of segmented GM, CSF and WM turn out by different techniques for representative slice images. In the first column is proved the original brain MRI images. Images in the second column represent the results generated by EM algorithm. Images in the third column and fourth column are the results generated by the conventional and enhanced FCM techniques respectively. Therefore the results of the improved FCM technique generate more accurate and reasonable segmentation of CSF, GM and WM from MRI data.

2016, Hind Rustum Mohammed, et al. [14] researched and produced an improved fuzzy c-mean algorithm that acquires with a reduction of time in discovering cluster and used in image segmentation. To analysis the enhanced fuzzy c-mean that implements with the support of using MATLAB and then it is compared with implementation of fuzzy c-mean algorithm, which is used by MATLAB by calling command FCM. To evaluate the beyond results of proposed fuzzy c-mean approach compared with the traditional fuzzy c-mean approach, finally both the proposed algorithm is an enormous enhancement in performance and implementation of traditional fuzzy c-mean in an accurate and speedy manner.

2016, Shiling Sun, et al. [15] analyzed the image segmentation that depends upon the traditional FCM algorithm, and proposed a fast fuzzy clustering algorithm. This research implements the brain MRI images of the Montreal neurological institute for simulation process. Traditional clustering image segmentation result, Traditional FCM image segmentation result, and image segmentation result of proposed algorithm is compared in this research. The proposed fast image segmentation is better than the traditional algorithm; this algorithm makes sure clustering optimization performance unmodified, to reduce the cost of operation.

2016, R. R. Gharieb, et al. [16] presented an approach to incorporating residual membership or local complement and image data information keen on the standard FCM algorithm. This aims at enhancing and regularizing the performance of the FCM algorithm for segmenting noisy and with-artifacts images. In this approach, a weighted regularizing function has been added to the standard FCM algorithm. The approach provides two algorithms, one with constant regularizing weight and the other with adaptive weight which is unique for each pixel. By the comparison of two proposed algorithms with the standard FCM and several modified FCM algorithms are tested and performed in an effective manner. In this simulation test, real-world and synthetic images are used and also an image is utilized that has a real artifact which is damage due to scratch. This has been noticed by correctly assigning the noisy pixels to the right cluster, by removing or fixing the scratch and also by the enhancement of the cluster validly measures. The experimental results illustrate that the proposed algorithms do better than the standard FCM and the other related algorithms.

2016, Balpreet Kaur, et al. [17] analyzed for achieving effective results for complex background images with the support of a fuzzy c means clustering method. The proposed technique is tested on different images and also it is analyzed using different performance evaluation parameters of pre-existing technique. The comparisons consist of graphs and tables that it considers as the effectiveness of the proposed technique. This work has not applied the features of DWT based image segmentation, so that an integrated model will be proposed to improve the results further.

2015, R.V.V.Krishna, et al. [18] proposed a color image segmentation algorithm by extracting both the color and texture features to the Sequential Minimal Optimization-Support Vector Machine (SMO-SVM) classifier for segmentation process. In this research, the SMO-SVM is trained using the samples obtained from Soft Rough Fuzzy-C-Means (SRFCM) clustering. Fuzzy set based membership functions competently perform with the difficulty of overlapping Clusters. Results have been completed on a lot of images from Berkeley segmentation database, which consists of more than 500 natural color images together with their Ground Truths. Finally, results
proves that intra clustering distance has been reduced and the soft rough fuzzy c-means clustering with SMO support vector machine inter cluster distance has been exploited. Different performance metrics are compared and the proposed algorithm demonstrates better results compared with other pre-existing benchmark algorithms. The proposed algorithm can also be extended to multi class support vector machine which increases the convergence speed. The proposed algorithm knows how to be used with noisy color images.

2015, Neda Hajibabaei, et al. [19] researched and presented the clustering based techniques and the FCM image segmentation. The proposed algorithm is capable of taking the spatial correlation between pixels into consideration and remove slight modify in intensity of homogenous regions. The spatial correlation between pixels is taken into account by defining a dissimilarity factor at the same time as evaluating the distance of pixels from the center of clusters. To contribute to the resemblance of modify in intensity of homogenous regions, a multiplicative field was applied. This multiplicative field which was bilateral filter was applied to input data and removed the change in intensity at the same time as preserving the edges. The enhanced FCM algorithm resulted in more correct image segmentation than conventional algorithm. Additionally, the results from applying this algorithm to the images available on semantic dataset attested to improved segmentation using this algorithm.

2015, Azzeddine Riahi, et al. [20] researched mainly focused on the FCM algorithm (Fuzzy c-means), the sum of degrees of membership of an individual given to all possible classes initially 1. To make the algorithm robust to ambiguous data and inaccuracies that can significantly affect on the classes centers, introduce the notion of ambiguity rejection. An exhaustive number of these variants were proposed in the literature to address the difficulty of noise sensitivity of conventional FCM algorithm. The results of image segmentation textured fuzzy classification; it depends upon Fuzzy C-means algorithm and its variants are represented. A series of tests carried out on an image to show the contribution of each method compared to the conventional FCM algorithm. To test the noisy image using Gaussian noise variance, test the noise sensitivity of the algorithm.

2013, Maoguo Gong, et al [ 21] proposed an unsupervised FCM algorithm that it depends on the kernel metric for segmenting images that have been corrupted by intensity in noise and homogeneties. In this research, the results reported and show that the kernel metric is an effective approach to making a robust image clustering algorithm. In addition to the new trade-off weight is mainly based on the distribution of the local spatial constraint and the local information, to affect the damping extent of the pixels in neighbors. To compare with its existences, it is capable to incorporate the local information more exact manner. In addition, the kernel distance measure and the trade-off weighted fuzzy factor are completely free of the empirically adjusted parameters determination, in that way allowing the automated applications. To test the proposed algorithm performs on natural images, medical images and synthetic images.

2013, Sirisha Konakala, et al. [22] analyzed and proposed both the distributions of the spatial interaction and the color space between nearby pixels during clustering process. The leads of this clustering algorithm are achieved the results from different wound images. The images are segmented into two classes, wound skin regions and normal skin regions, by utilizing neighboring data to force the algorithm to make regions. To recognize major trouble of the wound skin color is identified so as to the spatial data mining techniques are used for this task and integrate with a segmentation technique to recognize important wound skin color regions in an image. The FCM method is to perform skin wound detection depending on decision rules in hybrid space. This research has shown the effectiveness of the algorithm.

2012, R. Subash Chandra Boss, et al. [23] proposed for performing the mammogram image segmentation process with the support of the FCM algorithm. Both the FCM and the K-Means algorithms are gathered using the features with the intention of segment the region of interests for additional classification. The performance of the FCM segmentation evaluates using MSE and RMSE measures. The benchmark K-Means algorithm outperforms by using the FCM segmentation algorithm. As a result of the mammogram segmentation knows how to be performed for the detection of abnormalities in human breast like circumscribed lesions, calcification etc.

2011, Tara Saikumar, et al. [24] researched a new image segmentation that depends color features through Fuzzy c-means clustering unsupervised algorithm. The whole work is partitioned into a two stages, initial development of color partition of satellite image using de-correlation. By using this two stage process, it is possible to save the computational cost for avoiding feature calculation in support of each pixel in the image. The different experiments take out on the above imagery process within MATLAB v7.6.

III. CONCLUSION

The Fuzzy c-means is the most popular enduring areas of research with the entire types of researchers that includes Mathematics, Computer science, and other spots of engineering, over and above all areas of optimization practices. Many difficulties handle from different areas have been efficiently rectified by performing with support of FCM and its different variants. Fuzzy C Means techniques conclude that fuzzy c-means algorithm will be most excellent algorithm for performing image segmentation. From this survey work most broadly used
Fuzzy C-Means clustering techniques of image segmentation is performed and analyzed.

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