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REVIEW ARTICLE

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FAST UNSUPERVISED BAYESIAN IMAGE SEGMENTATION WITH ADAPTIVE SPATIAL REGULARIZATION: A REVIEW

Manisha
M.Tech Scholar
ECE Department, D.C.R.U.S.T,
Murthal,India

Gitanjali Pandove
Associate Professor
ECE Department, D.C.R.U.S.T,
Murthal,India

Abstract: Image segmentation is a process of dividing the image in to some distinct regions. These region shave specially coherent in nature and have similar attributes. This technique is widely used for image analyses and to interpret the desired feature. In this present paper we will study about the hidden Markov random fields and find its expectation maximization algorithm.

Keywords *:*Image Segmentation, Bayesian Methods, Spatial Mixture Models, Potts Markov random field, Convex Optimization.

1. INTRODUCTION

If we study about the image possessing system, the resulted image may contain some irregularities or defects that may affect our process. Furthermore these kind of defects can be adjusted by various kind of techniques like increase the number f picture from the same scene which decrease the effect of defect and by using a higher quality instruments, but such methods which are based on the external hardware are consume more time and they increase the cost too [1]. So to avoid such effect of external hardware we often used computer programs which consume very less time and reduce the cost. For example to remove the noise defect we can use smooth filter which effectively reduce the noise content and filter the image or to change the contrast level in a low contrast image we can use image histogram by which level can be scaled. Such correction of various defect in image is called image pre processing [2]. After removing the defects the process of image segmentation occurs. For example segmentation of food image which means to distinguish automatically the food products from an image is obviously carried out after image acquisition because this process of segmentation is completely carried out by the computer programs and there is no need of human intervention between the process the computer itself recognize the food items. If we defining the image segmentation in simple words, the image segmentation process divide the image in to several well defined regions. All these regions have similar pixels characteristics and attributes.As image segmentation is a important task because all the object classification and object measurement i.e. interpretation task is completely based on the results of segmentation process. A high quality of effort are being used to obtain an optimal segmentation techniques but till now there is no such technique are available. [3]. But still there are various kind of segmentation techniques are available which gives effective results. In food industry four kind of segmentation techniques are most used which are thresholding-based, region-based, gradient-based, and classification-based segmentation. But these techniques cannot provide a high accuracy result if it used for a wide range of food products. Some further methods which are ancombined effect of above techniques are also being developed that compromise on accuracy of results [4].

The complete research paper is described in five sections. The introduction is described in Section I,Section II describes literature review, Section III describes problem formulation,Performance parameter describe in section IV, Finally, Section V describes the conclusion of paper.

2. LITERATURE REVIEW

This section will provide the brief description and highlights the contribution, remarks and factors of the work done by the researchers. Many attempts have been made in the past to achieve the maximum accuracy while segmented the images.

Pereyra, Marcelo et.al highlighted about Bayesian image segmentation methodology that is used to compare the simulation results by an estimated result which is generated by an algorithmic method which is Markov chain Monte Carlo algorithm. Accuracy was found out 95% − 99%.Regularization parameterforLung, Bacteria, Brain and SAR was0.065, 0.110, 0.095,and 6.6314 respectively [1].FitsumMesadi et.al highlighted about Disjunctive Normal Level Set method. On the other hand another technique DNSM was also used for single object segmentation. DICE Score was achieved up to 98.5% This technique was provided better computational time [2].ErtuncErdil et.al proposed about segmentation using nonparametric joint shape. Feature priors technique was used. Dice score and average hausdorff desistance was achieved up to 0.9409 and 10.5742. after calculating all these calculation we can calculate a average Dice score on basis of ground truth which is 0.9153 [3]. Shifeng Wang et.al proposed MRF model. MRF model is suitable for expressing a connection between the random variables. The system had the four sensors forward-looking LRF (LRF1), Accelerometer (Acc), camera (Cam), Downward looking (LRF2). Classification accuracy forMRF, acceleration based, Image based and downward LRF was 97.5 %, 69.4 %, 88.8 % and 82.3 % respectively [4].Ronghua Shang et.al described about Fast FCM clustering based on key pixels. The algorithm was separated the whole image into two parts

Key pixels,non-key pixels. For Image 256 × 256, 1 look SA, 2 look SA, 4 look SA were 97.05, 98.48 and 98.65 [5].Dona Francis et.al described third generation of artificial neural networks Pulse Coupled Neural network was used. The PCNN neuron consists of three compartments receive field, modulation and pulse Generator.Total 40 images are input to PCNN engine and false positive rate is 0.031989 [6]. AnuvaKulkarni et.al proposedthatRW algorithm had been used for image segmentation. Hash codes were used instead of raw pixels and hamming distance between the hash codes as the distance metric. Ground truth value Image1, Image 2, Image 3 and Image 4 was96.61 %,96.49 %, 88.92 %and98.29 %respectively [7].Javier Gimenez et.al highlighted about Bayesian model, Potts Model are also used for comparison MSE, Standard Deviation and Mean of Estimators computed over 100 Realizations of a Potts Model.For several values of β Gaussian datawith$\sigma = 15$,k=1 [8].

TABLE: 1Literature Review Table

Reference	**Paper Title**	**Research Methodology used**	**Major Findings**	**Research prospects**
[1]	Fast unsupervised Bayesian image segmentation with adaptive spatial regularization	Bayesian image segmentation methodology is used &compare the results with the estimates produced by the Markov chain Monte Carlo algorithm	Accuracy: 95%−99%. Regularization parameter For Lung, = 0.065; For Bacteria, = 0.110 For Brain = 0.095 For SAR, = 6.6314.	This technique is applicable for the number of images *K (is* unknown). These applications are used to Ultra sound and PET image segmentation
[2]	Disjunctive Normal Parametric Level set with application to image Segmentation	Disjunctive Normal Level Set method is used. On the other hand another technique DNSM has recently been used for a single object segmentation	DICE Score : 98.5% The technique provides better computational time.	The proposed DNLS-multiphase approach has the highly desired properties that it is less sensitive to initialization, and its computational cost and memory requirement
[3]	Nonparametric Joint Shape and Feature Priors for Image Segmentation	MNIST handwritten digits data set is used. Segmentation using nonparametric joint shape and feature priors technique is used.	Dice score : 0.9409 Average Hausdorff distance : 10.5742 The average Dice score (Hausdorff distance) results on all test images with respect to ground Truths are 0.9153 (1.7899).	The proposed method minimizes an energy function that includes a joint nonparametric shape and feature .
[4]	Two-Stage Road Terrain Identification Approach for Land Vehicles Using Feature-Based and Markov Random Field Algorithm	MRF model is suited to express causal relationships between random variables which stem from the four sensors 1. forward-looking LRF (LRF1) 2. Accelerometer (Acc) 3. Camera (Cam) 4. Downward looking	Classification accuracy MRF : 97.5 % Acceleration based : 69.4 % Image Based : 88.8 % Downward LRF: 82.3 %.	MRF algorithm was presented to improve the terrain classification accuracy for land vehicles.

		(LRF2).		
[5]	A Fast Algorithm for SAR Image Segmentation Based on Key Pixels	Fast FCM clustering based on key pixels. The algorithm separates the whole image into two parts Key pixels Non-key pixels.	Image 1 (244 ×244) : 1 look SA: 98.21 2 look SA: 98.60 4 look SA: 98.80 Image2 (256 ×256): 1 look SA: 97.05 2 look SA: 98.48 4 look SA: 98.65	Improving the algorithm in terms of preserving edges and other details of the original image, and the level-set methods may offer a potential way forward.
[6]	Fundus /Mage Vessel Segmentation Using PCNN Model	Third generation of artificial neural networks Pulse Coupled Neural network is used. The PCNN neuron consist ofthree compartments 1. Receive field 2. Modulation 3. PulseGenerator	Total 40 images is input to PCNN engine FPR : 0.031989	The algorithm's characteristics of pixel misclassification are low while comparing with other algorithms.
[7]	Unsupervised Image Segmentation Using Comparative Reasoning and Random Walks	RW algorithm has been used for image segmentation Hash codes used instead of raw pixels and hamming distance between the hash codes as the distance metric	Ground truth value Image 1 : 96.61 % Image 2 : 96.49 % Image 3 : 88.92 % Image 4 : 98.29 %	The algorithm saves in computation time. It was found that Proposed method performed better than state of the art methods.
[8]	When Data Do Not Bring Information: A Case Study in Markov Random Fields Estimation	A Bayesian model is used Potts Model is also used for comparison	MSE, Standard Deviation and Mean of Estimators computed over100 Realizations Of A Potts Model For Several Values of β Gaussian Data with $\sigma = 15$, k=1	Posterior PML have interesting statistical properties such as consistency, asymptotic normality, as the prior estimators do. .

3. PROBLEM FORMULATION

Owing to the defects that are present in an image acquisition system, some techniques are performed to remove such kind of defects like image pre processing and histogram manipulation are performed to eliminate the noise content and to change the contrast level in an image of low contrast level [8].Later on, image segmentation process is used to distinguish the eatable items from the background by analyzing the regions. In account of this as the image segmentation process is still not well defined so not a single methods described above can perform ideally and cannot give a high accuracy results. To get the better results and to increase the efficiency we can use the combination of several techniques that may give an efficient result and also increase the segmentation speed. The main objective of the paper is to study and analyze image segmentation Approaches [7-10]. The approaches weresuch as Markov random field and its expectation-maximization algorithm will be studied in depth.

4. PERFORMANCE PARAMETERS

The performance of segmentation is measure withJacard score, Precision rate, Recall rate and Dice score.

1. Jacard Score

For an every segmented region there exist an binary map for that which is well followed by the probabilistic algorithms and an another factor T which is consensus truth and from these elements we can collect Dice score [11]:

$$\text{Dice (P, T)} = \frac{|P_1 \cap T_1|}{(|P_1 + |T_1||)/2}$$

Here ∩is a AND logical operator which used for an definite function, j describes the size of an set (i.e., the number of

voxels belonging to it), and P1 and T1 shows the set of voxels where P = 1 and T = 1. Dice score element normalize the true positives numbers to the distinct segmented are i.e. it have similar identity like the F score which is an harmonic mean of an recall curve and if desire we can also transform it into theJacard score.

2. Recall Rate

Recall Rate measure how many of the positives does the model. It is the proportion of positive cases that were correctly identified, as calculated as [12]

$$Recall = \frac{A}{A+B}$$

3. Precision Rate

Precision Rate is how many of the returned documents are correct. P is the proportion of the predicted positive cases that were correct & calculate as [13]

$$Precesion = \frac{A}{A+C}$$

4. Segmentation Time

It is the total time takes place during segmentation of an image.

5. Accuracy

The accuracy of a test is completely based on the capability of the test to distinguish the patient and healthy cases efficiently. To compute the accuracy of an system we calculate the ration of true positive and true negatives in all the performed cases. Mathematically, this can be stated as [14]:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

5. CONCLUSION

In this paper we try to present a innovative approach for the efficient image segmentation process. Our new approach is basically relied on the Bayesian estimation method which is used for estimating the variable regions that are being hide and have irregular parameters β. The estimator thus use for the estimation of hidden region is relied on the minute variance analysis of a Bayesian model and combined with the convex relaxation.

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