Research Article

Improving the Performance and Accuracy of Image Segmentation Using Modified FCM Algorithm

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Abstract: The image segmentation particularly refers to the breaking up of digital image into number of segments. The each segment of an image may be termed as region or a category which is equivalent to different object or part of it. It is the most important step in the image analysis. If the segmentation is good the analysis can be made quite easily. Segmentation bridges the gap between low-level image processing and the high-level image processing. The main aim of this process is to recognize the objects even better so as to provide accuracy. It has a wide variety of applications such as in the medical field which helps to do surgery, diagnosis, and to locate any tumors. It has wide spread applications in recognition, forensic science and traffic control systems. There are various algorithms to do segmentation of the image in this paper we concentrate on FCM based algorithm for the segmentation.

Asian Journal of Engineering and Technology Innovation
Volume 4, Issue 7
Published on: 7/05/2016

Cite this article as: Hemalatha K.L *et al.* Improving the Performance and Accuracy of Image Segmentation Using Modified FCM Algorithm. Asian Journal of Enginnering Technology and Innovation, Vol 4(7): 156-158, 2016.

I. INTRODUCTION

Image processing is broadly used in this era where there is a dominance of the usage of the computers. So, in the process of the image segmentation, each segment is important in order to computer to understand and manipulate it. Image segmentation can even change its representation so as to bring more meaning to the image and make the user to analyze the image even better. [1] There are numerous methods in the process of segmenting the image the few of them are thresholding, clustering and classification etc. In clustering there may be types such as hard clustering and fuzzy clustering which has its own features. The [2] and [3] speaks about the importance of the image segmentation in the field of the biomedical applications in which radiologists segments the images into more meaningful regions and work based on it. In [4] and [6] it tells about the importance of the usage of the fuzzy c-means algorithm for the image segmentation process and in [7] it provides a better and efficient way to use the algorithm which is very robust. The Clustering operation from [8] and [9] specifies that clustering is most widely used in image segmentation techniques in order to classify the patterns such that the patterns in the different group will match each other. The Fuzzy C-Means (FCM) is widely used because of its flexibility but it is more time consuming and hence less accurate. It gives very good result for the overlapped type of data in the image. The data point may belong to more than one cluster. The distance for the each data points and cluster center are formed for all the clusters. It is very consistent because it doesn't assign any initial clusters randomly.

RELATED WORK

One of the most difficult tasks in the image processing is the segmentation of the image for the pattern recognition. [5] The segmentation process helps in the partitioning of the image into a disjoint form of sets. The segmentation is the most efficient step in the pattern recognition process based on the images.

The segmentation is the most difficult task [10] in the image processing because if there is any fault in the image segmentation there are chances that the measuring will go wrong and it won't provide the expected results.

The most important aspect of the image segmentation is the Spatially non-uniform regions can be found using this technique. The Higher-level problems the image processing such as recognition and indexing can be resolved up to some extent. But if the objects and background take different ranges we can mark its pixels by the process called threshold. Thersholding groups the pixels together according to some of the defined attribute it may be termed as the global attribute. The two pixels in the image are selected randomly, if they are

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not related in any way. There is a possibility that we can differentiate among the pixels by assuming that the pixels belong to the same set of regions. The segmenting of an image is the dividing it in a uniform way such that if it is divided into an smaller regions such that pixels in a different region satisfy the global uniformity of the image in the system. But there should be some criteria in splitting up of the image such that it is uniform. The pixels in the images can be grouped based on the intensity. The pixels which belong to certain range are grouped into class and other pixels with different intensity will be grouped into different class. The global threshold value is calculated by comparing the existing threshold value and the partition value of the segment in the image. So, taking into account of all these factors in this paper the solution to the problem has been addressed.

Existing System

The Fuzzy C-means(FCM) technique does the data clustering in which the dataset is grouped into number of clusters and assigns a datapoint which assigns to all the dataset in the clusters. [7] Given a criteria to the system, the FCM technique does some partition in which a collection of finite set of pixels into a fuzzy clusters. The existing FCM technique is as follows: It is based on this function:

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{C} u_{ij}^{m} \left\| x_i - c_j \right\|^2 , \quad 1 \le m < \infty \qquad (1)$$

where m is any real number greater than 1, u_{ij} is the degree of membership of x_i in the cluster j, x_i is the ith of d-dimensional measured data, c_j is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center.

An iteration optimization is carried out to FCM technique with the update of membership u_{ij} and the cluster centers c_j by:

$$u_{ij} = \frac{1}{\sum_{k=1}^{C}\left(\frac{\left\| x_i - c_j \right\|}{\left\| x_i - c_k \right\|}\right)^{\frac{2}{m-1}}} , \qquad c_j = \frac{\sum_{i=1}^{N} u_{ij}^{m} \cdot x_i}{\sum_{i=1}^{N} u_{ij}^{m}} \qquad (2)$$

This iteration will stop when the function

$$\max_{ij}\left\{\left|u_{ij}^{(k+1)} - u_{ij}^{(k)}\right|\right\} < \varepsilon .$$

Where ε is a termination criterion between 0 and 1, whereas k are the iteration steps. This procedure converges to a local minimum or a saddle point of J_m.

As above mentioned this FCM technique is less accurate and it consumes more time so in this paper the proposed system had made an attempt to overcome this problem and approached towards its betterment.

Proposed System

In this proposed system it is taken care that the algorithm should work better and improves its performance. In order to overcome all these drawbacks the number of iterations it carries out must reduce. This is achieved by calculating the distance between the pixel of the image and the centroid. Then update the membership value of the pixels from the image and compare its distance and threshold value and carry out the segmentation process based on the comparisons made.
The algorithm for the proposed system is as follows:

Algorithm Improved version of FCM Technique
Require: img: input image, n: Number of clusters
1. Accept the input image and read the data.
2. Accept the number of clusters to be formed.
3. Initialize fuzzy factor
4. **for** i = 0 to MAX **do**
5. // Calculate the distance between
a. // pixel and centroid.
6. // Calculate the membership value.
7. **end for**
8. **if** distance < threshold
9. // Calculate membership values and
a. // update cluster centroid values
10. **else**
11. // Find its objective function
12. **end if**
13. Process the Segmentation

In this algorithm an input from the user for the number of nodes an input image is taken. The fuzzy factor can be a user defined or the random value and it should be initialized. In the each iteration the the distance between the pixel and centroid is calculated and membership value will be updated else if the value is less the threshold value is calculated. Finally, the segmentation process is carried out based on the threshold value.

Conclusion

The proposed algorithm can be used where there is huge amount of data to be segmented such as in medical field which provides the correct result about the problem. In presence of the iterative technique it is more mathematically reliable. It has a better anti-noise performance. As the distance between the pixel and centroid calculated early and threshold value comparison are made this algorithm work faster than the traditional FCM algorithm. It is independent of the noises in the image. As there are comparison operations that are made better results are obtained. The detection from this method produces a better result from the segmentation. It doesn't alter the details of the image. Hence, the system is accurate.

Acknowledgment

The paper written with interest by the authors and thank the comments from the anonymous reviewers, who would in turn help in improving this paper.

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