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Survey on Various Image Segmentation Techniques

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Abstract: ***Image segmentation is considered one of the most significant image processing techniques. The technique of splitting or partitioning an image into bits, called segments, is known as image segmentation. It's most effective for applications like image compression and object detection, since processing the whole image is wasteful in these cases.As a result, image segmentation is used to separate the image's components for further processing. Digital image processing techniques allow for computer-assisted editing of digital images. Pre-processing, enhancement and display, and content retrieval are the general processes that all forms of data must go through by using modern technology. In image processing, image segmentation is a critical stage. Image segmentation strategies such as Thresh-holding, Edge Detection, Colour dependent binary Image segmentation, and Biogeography Based Optimization are studied in this paper and their precision, sensitivity, and specificity are evaluated.***

Keywords: Image segmentation, edge detection, fuzzy clustering, thresh-holding, and biogeography-based optimization are some of the techniques used

1. Introduction

Most recent uses of digital image processing can be seen in the fields of remote sensing, medicine, imaging, film and video making, and security monitoring. In the areas of image processing, especially in the domain of image segmentation, new advanced technologies are emerging.

Image Segmentation

“The method of splitting a digital image into several segments, such as a group of pixels, also known as super pixels, is known as segmentation. Segmentation's key goal is to simplify and transform an image's representation into a coherent image that is more suitable and easier to interpret. Segmentation is a collection of techniques for spatially partitioning close sections of an image into objects. The term "image segmentation" refers to a crucial feature of digital image processing. Picture segmentation is the method of assigning pixels to homogeneous and disjoint regions that form a partition of an image with similar visual characteristics. The main goal is to divide a picture into subparts depending on those characteristics. Certain boundaries, contours, colours, intensities, or texture patterns, geometric shapes, or some other pattern could be used to create features. Image segmentation is a technique for locating and identifying objects and borders in an image. A simple area-based image segmentation approach is region expanding. Since it requires the collection of initial seed points, it is also known as a pixel-based image segmentation process. This method of segmentation looks at the pixels around the initial "seed point" to see if they can be included in the field. [1].

Applications of segmentation

Picture segmentation has a variety of practical uses, including:

1) Locate tumours and other pathologies using medical imaging
   - Take measurements of tissue sizes.
   - Using a computer to direct surgery
   - Diagnosis
   - Treatment preparation
   - Anatomical structure analysis
2) Use satellite imagery to locate objects (roads, forests, etc.)
3) Identification of faces
4) Identification of fingerprints
5) Traffic management networks that are automated
6) Computer vision

Segmentation Techniques

The below are the different types of segmentation.

- Object Detection Segmentation
- Adaptive threshold Segmentation
- Segmentation based on region
- Segmentation based on feature
- Segmentation based on optimization techniques

Comparison of Various Segmentation Techniques

Table 1: Comparison table

Segmentation technique	Description	Advantages	Disadvantages
Thresholding Method	based on the histogram peaks of the image to find particular threshold values	no need of previous information, simplest method	highly dependent on peaks, spatial details are not considered
Edge Based Method	based on discontinuity detection	good for images having better contrast between objects	not suitable for wrong detected or too many edges
Region Based Method	based on partitioning image into homogeneous regions	more immune to noise, useful when it is easy to define similarity criteria	expensive method in terms of time and memory
Clustering Method	based on division into homogeneous clusters	fuzzy uses partial membership therefore more useful for real problems	determining membership function is not easy
Watershed Method	based on topological interpretation	results are more stable, detected boundaries are continuous	complex calculation of gradients

2. Optimization Techniques

The act, mechanism, or technique of optimizing something to make it completely usable or as efficient as possible. There are three categories of optimization processes, each of which is defined as follows:

1) Direct search method:-This approach is used to solve optimization problems that do not require knowledge of the subjective function's gradient. The benefit of this approach is that it can be used to solve problems that aren't even continuous. This approach looks for a series of points around the current point where the function's value is less than the actual point's value.
2) Gradient method:-This approach is used to solve problems that require the use of a derivative. Gradient approaches make use of knowledge from the optimization function's derivatives to better direct the search and locate optimal solutions faster. The downside of this approach is that it can only be used to solve problems that are ongoing.
3) Nature inspired method:-We use nature-inspired approaches to solve the problem of finding local maxima or minima, or to solve the problem of finding the best solution. Both constant and discrete functions can be used in this system. This approach is an appealing solution for resolving complicated questions that cannot be overcome using traditional methods such as the principle of evolution and behavioural patterns of various organisms. The following are few examples of nature-inspired methods:-ACO(Ant Colony Optimization)
   PSO (Particle Swarm Optimization)
   GA (Genetic Algorithm)
   ES (Evolutionary Strategies)
   DE (Differential Evolution)
   SGA (Stud Genetic Algorithm)
   PBIL (Population Based Incremental Learning)
   BBO (Biogeography Based Optimization)

Biogeography Based Optimization

Optimization based on biogeography is a form of evolutionary algorithm. BBO is focused on the statistical analysis of biogeography, as the name suggests. The study of the distribution of animals and plants over time and space is known as biogeography.

BBO is an evolutionary mechanism that allows animals to share information by migration. To accomplish knowledge exchange, it is modelled after the emigration and immigration of species between ecosystems. BBO works by transferring knowledge between people, resulting in the alteration of an actual person. Individuals should not disappear as a century comes to an end. BBO has the unique feature of not discarding the initial population after each generation, but rather modifying it by migration. BBO is a population-based optimization algorithm that doesn't require reproduction or the birth of "children." The first mathematical equations governing the distribution of species were discovered and established in 1960. As a result, biogeographic statistical models explain how species move from one island to another, how new species emerge, and how species go extinct. The HSI and LSI standards are the foundations of the biogeography methodology. Highly suitable geographical areas are said to have a high suitability index because they are more adapted and more compatible for biological organisms to live in (HSI). Rainfall, diversity of vegetation, diversity of topographic features, surface area, and temperature are all variables that correlate with HSI. Suitability index variables are the variables that define habitability (SIV). HSI habitats have a large number of species, while LSI habitats have a limited number of species. The HSI is more static than the LSI. Because of their small population, LSI has a high rate of species immigration.

Immigration and emigration of organisms are used in this method to calculate the best match value, also known as fitness. The number of species living in a given location or ecosystem is referred to as population size. Until optimization, each person in the population is assessed, and then the migration and mutation stages are followed.

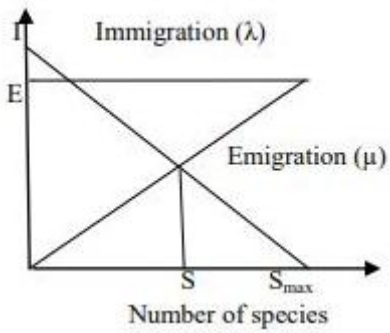

Figure 1: Species Model

3. Related Work

In this paper, Chih-Tang Chang et al. [1] presented a fuzzy k-means clustering algorithm that reduces the computational complexity of a conventional fuzzy k-means clustering algorithm by using cluster centre displacement between successive iterative processes. The proposed method, dubbed CDFKM, divides cluster centres into two groups: active and stable. In the iterative procedure, this approach skips the distance calculations for stable clusters. The authors present an algorithm for determining the initial cluster centre for CDFKM to speed up the convergence of CDFKM.

In this article, Mittu Mittal et al. suggested a Biogeography Based Optimization method for automatically grouping pixels in an image into separate homogeneous regions. Biogeography is the study of biological organisms' spatial distribution. BBO is essentially an optimization method that does not require replication or the generation of "children." Image segmentation has been performed for several years using a variety of techniques such as PSO, ACO, clustering algorithms, GA, ABC, and so on. The BBO approach to image segmentation, i.e. partitioning an image into several segments, is discussed in this article.

M.R. Lohokare et al. [3] in this paper proved the efficiency of BBO for block motion estimation in video coding. Motion rewarded video coding method, which anticipates current frame from previous frame, has been used to exploit the regression equation between successive frames. Established search methods are related to the proposed methodology.

Surbhi Gupta et al. [4] suggested a Biogeography Driven Optimization-based colour quantization algorithm for paper images (BBO).

BBO is a population-based optimization algorithm that focuses on the distribution of species across neighbouring islands and uses similar measures to find near-optimal solutions as evolutionary algorithms. The Color Quantization module's goal is to reduce the number of colours in an image in order to reduce storage requirements. This reduction does not degrade the image's accuracy, so that the human eye cannot tell the difference between the original and the changed image. In this article, the BBO method is used to evaluate the nearby colours, and the far off colours are dropped so that the consumer notices the change the least.

In this article, Farhad Soleimanian Gharehchopogh et al. [5] study the k-means fuzzy and k-means algorithms in order to identify intrusion detection in systems, all of which use the clustering approach. Intrusion Detection System is one of the most powerful tools (IDS). This technology was created to provide full protection in a computerised system, allowing the intrusion detection system to move through the firewall, antivirus, and other security equipment. The methods for detecting intrusions are classified into two categories: supervised learning and unsupervised learning. Clustering is one of the branches of unsupervised learning that is widely used to detect potential threats. Fuzzy sets play an important role in reducing false alerts and intrusion detection, all of which have a high level of uncertainty.

In this paper, Er.KrishmaBhuchar et al. [6] present a global optimization process. Automatically sorting the pixels of a colour image into disjoint homogenous regions dependent on biogeography. The study of the distribution of animals and plants over time and space is known as biogeography. It creates various clusters based on the visual characteristics of an input file, such as colours, strength, or texture pattern.In comparison to other evolutionary algorithms, the proposed algorithm computes output estimation in terms of migration rate, such as 0.4.

In this article, Surbhi Gupta et al. [7] suggested a Biogeography Based Optimization method for automatically grouping pixels in an image into separate homogeneous regions.

Biogeography is the study of biological organisms' spatial distribution. BBO is a form of optimization technique that does not require replication or the generation of "children." Image segmentation has been performed for several years using a variety of strategies such as PSO, ACO, and others. The BBO approach to image segmentation, i.e. partitioning an image into several segments, is discussed in this article.

SoumiGhosh et al. [8] in this proposed two important clustering algorithms namely centroid based K-Means and representative object based FCM (Fuzzy C-Means) clustering algorithms are compared. These algorithms are used, and the efficiency of the clustering output is used to determine results. The number of data points and clusters are the two variables that are used to analyse the behaviour dynamics of both algorithms. FCM provides results that are similar to K-Means clustering, but it takes longer to compute than K-Means clustering.

Using a Biogeography Based Optimization approach, RajwinderKaur et al. [9] suggested methods for quantization of multiple medical images such as MRI and X-Ray. Color quantization is a technique for reducing the number of colours in an image while retaining the most significant colour detail while compromising on others. If the display on which a particular image is displayed has less colour than the original image, colour image quantization is needed. In certain medical imaging applications, colour quantization is crucial.

Gaganpreet Kaur et al. [10] in this paper presented a novel approach Biogeography based optimization for the segmentation of Medical images. Image segmentation is done with many techniques like PSO, ACO etc. For partitioning an image into several fragments, a Biogeography Based Optimization technique for image segmentation is used.

4. Proposed Work

Image segmentation is a critical issue in computer vision that requires a thorough understanding of the image in order to achieve better outcomes, i.e., the recognition of homogeneous regions in the image. It has been the focus of

much study for the past three decades. For this reason, several algorithms have been created. To solve the segmentation problem, several clustering algorithms are commonly used. For image segmentation, we use a modern Biogeography technique. BBO is a population-based optimization algorithm that does not require fertility or child-rearing. We began by selecting a seed based on a collection of predetermined parameters. After that, look at the seeds points' neighbours and measure the MSE colour gap between them. If we use an RGB image, the MSE colour distance is calculated. When we use the LAB colour space, we measure the CMC colour gap between adjacent pixels. Make three islands using the BBO method: HSI, MSI, and LSI.

Research Objectives

1) Study multiple image segmentation strategies.
2) Study multiple optimization methods like BBO, ACO, and PBO etc.
3) Use BBO to perform image segmentation.
4) Apply fuzzy k means to image segmentation.
5) Measure the elapsed time between all procedures and compare the two methods on the basis of time.

Research Methdology

- Understanding of BBO (biogeography-based optimization and image segmentation) as well as neural networks
- In BBO, choose the population size, fitness function, and lambda.
- Specify the scale of the field in BBO.
- Use BBO to pick lambda in segmentation
- In segmentation, the contour point and fitness value are calculated.
- Calculate the elapsed time using the BBO method.
- Using the blurry k means technique, calculate the elapsed time.
- The findings show that BBO produces better results than fuzzy k means.

5. Conclusion

Various image segmentation techniques are defined in detail and compared in this study of image segmentation techniques. Both of these methods are appropriate for a wide range of medical image uses. These methods may be used to recognise and detect objects. These can be used to detect tumours in medical imagery and to detect highways and bridges in satellite images. As a result, it is obvious that different approaches are appropriate for different types of image applications. However, it is obvious from the research that no single approach is adequate for all image types, and no single method is appropriate for all image types. It faces a difficult future due to the need for image segmentation in many applications.

References

[1] Chih-Tang Chang, Jim Z. C. Lai, Mu-Der Jeng, "A Fuzzy K-means Clustering Algorithm Using Cluster Center Displacement", Journal Of Information Science and Engineering 27, 995-1009, 2011.

[2] Mittu Mittal, Gagandeep, "A New Evolutionary Algorithm developed forGlobal Optimization (BBO)", *International Journal of Science, Engineering and Technology Research (IJSETR)Volume 2, Issue 2, Feb. 2001.*

[3] M.R. Lohokare, S.S. Pattnaik, S. Devi, K.M. Bakwad, D.G. Jadhav," Biogeography-Based Optimization Technique For Block-Based Motion Estimation In Video Coding", NCCI 2010 -National Conference On Computational Instrumentation CSIO Chandigarh, INDIA, Pp. 67-71, 19-20 Mar. 2010.

[4] Surbhi Gupta 1, DeeptiBhardwaj 2, Parvinder S. Sandhu, "Color Quantization in Document Images Using Biogeography BasedOptimization", *2011 International Conference on Software and Computer ApplicationsIPCSIT vol.9, pp. 72-78, 2011 IACSIT Press, Singapore.*

[5] FarhadSoleimanianGharehchopogh, NedaJabbari, ZeinabGhaffariAzar, "Evaluation of Fuzzy K-Means And K-Means Clustering Algorithms in Intrusion Detection Systems",International Journal Of Scientific & Technology Research Volume 1, Issue 11, pp. 67-72, Dec. 2012.

[6] Er.KrishmaBhuchar, ER. Rekha Rani, ER.BhartiJyoti, "Performance Evaluation of Biogeography BasedImage Segmentation", *Proc. of the Intl. Conf. on Advances in Computer Science and Electronics Engineering, pp. 119-123, 2012.*

[7] Surbhi Gupta 1, KrishmaBhuchar 2, Parvinder S. Sandhu, "Implementing Color Image Segmentation Using Biogeography BasedOptimization",*2011 International Conference on Software and Computer ApplicationsIPCSIT vol.9, pp. 79-86, 2011 IACSIT Press, Singapore.*

[8] SoumiGhosh, Sanjay Kumar Dubey, "Comparative Analysis of K-Means and Fuzzy C-Means Algorithms",*International Journal of Advanced Computer Science and Applications, Vol. 4, No.4, pp. 35-39, 2013.*

[9] RajwinderKaur, RakeshKhanna, "Medical Image Quantization using Biogeography based Optimization", *International Journal of Computer Applications (0975 – 888) Volume 48– No.12, pp. 7-10. Jun. 2012.*

[10] GaganpreetKaur, Harpreetkaur, "A Review on Medical Image Segmentation Using Biogeography Based Optimization", *International Journal of Emerging Research in Management &Technology, Volume-2, Issue-4,* pp. 35-38, Apr. 2013.

[11] F. Charif, A. Benchabane and Z. Bebboukha, "Multimodal Medical Images Registration Using Biogeography-Based Optimization Algorithm," 2019 6th International Conference on Image and Signal Processing and their Applications (ISPA), Mostaganem, Algeria, 2019, pp. 1-5, doi: 10.1109/ISPA48434.2019.8966862.

[12] F. Charif, A. Benchabane and Z. Bebboukha, "Multimodal Medical Images Registration Using Biogeography-Based Optimization Algorithm," 2019 6th International Conference on Image and Signal Processing and their Applications (ISPA), Mostaganem, Algeria, 2019, pp. 1-5, doi: 10.1109/ISPA48434.2019.8966862