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Review Article

An Overview of Techniques for Various Image Segmentation

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Abstract

One of the most important image processing tasks is thought to be image segmentation. The process of splitting or partitioning an image into what are known as segments is known as image segmentation. Since it is inefficient to process the entire image for these kinds of applications, it is mostly helpful for image compression and object recognition applications. In order to separate the portions of a picture for additional processing, image segmentation is utilized. Many image segmentation algorithms are available that divide a picture into multiple segments according to certain properties such as color, texture, and pixel intensity value. These methods are all grouped according on the segmentation approach that was applied. This study reviews and discusses numerous image segmentation approaches, and ends with a comparison of their benefits and drawback

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1. Introduction

An image is a depiction of anything that is visible and has an abundance of helpful data. The analysis and extraction of information from images without modifying the image's other features in order to achieve certain goals is one of the main uses of digital image technology. [1]. The most crucial topics in computer science and computer engineering are pattern recognition, image analysis, and image disciplines because of their numerous applications in the military, medical field, astronomy, and other real-world fields [2]. These days, novel technologies are being developed in the field of image processing, particularly in the segmentation of pictures. Image segmentation is an important but difficult process [3].

picture segmentation is the most crucial step in picture analysis. Picture segmentation is the process of dividing a picture into homogeneous sections that, ideally, correspond to real objects in the scene and are based on specific criteria. In practice, image segmentation is used to display easier-to-understand data, including color or texture, in later stages of a standard recognition system [4]. To make a video from a multi-media perspective, image segmentation can be applied to one image or a set of photos. Although the splitting of a digital image into its continuous, unconnected, and nonempty segments to aid in attribute extraction is known as image segmentation, the main goal of segmentation is to decrease data for a simpler analysis procedure. Picture segmentation is still an active and expanding area of research in image processing. For researchers and developers, creating a uniform method for image segmentation is still a challenging task

[5]. Fundamental requirements for effective picture segmentation consist of:

• Every pixel within the area is a part of an image.

• A region is linked if any two pixels within it may be connected by a line that stays inside it.

• With regard to a particular attribute, every region is identical. The attribute may have a semantic foundation or be syntactic (intensity, hue, and texture).

• Neighboring regions cannot be combined into one homogeneous area.

• No region overlaps with another. [5]

Segmentation is mostly used to simplify images, or to portray them in a form that is straightforward and expressive, so that only the objects of interest are examined in the object analysis stage [3]. However, improper segmentation will result in a decline in object measurement and classification performance.

The remaining sections of the article are arranged as follows. Section2 : Algorithm Classification , The Literature Study is then covered in Section 3. . Section 4: Image Segmentation Techniques . While concludes and future work in Section 5

2. Algorithm Classification

There are numerous methods now in use for segmenting images. Each of these strategies has significance in and of itself. These methods can all be accessed through one of two fundamental segmentation approaches: edge-based or region-based. Each technique can be used on various photos to accomplish the necessary segmentation. Additionally, these methods can be divided into three groups. [4]

A. Methods of Structural Segmentation

The image segmentation approaches known as structural techniques focus on the structure of the needed region, or the specific area of the image that needs to be segmented.

B. Techniques for Stochastic Segmentation

Rather than utilizing the structural details of the area, stochastic image segmentation algorithms work with the discrete pixel values of the picture.

C. Hybrid Methodologies

The term "hybrid techniques" refers to picture segmentation methods that combine the principles of the two methods mentioned above, i.e., the use of discrete pixels and structural information [5]. This

paper's subsequent sections compare and discuss the various segmentation strategies. To keep things simple, no mathematical explanation is used; instead, all of the strategies are explained philosophically. The artificial neural network-based thresholding method, region-based, clustering-based, watershed-based, partial differential equation-based, and edge detection-based and other methods are frequently used for picture segmentation. Regarding the approach each strategy takes to segment data, these are all distinct from one another[5][6].

With so many segmentation algorithms being created, classifying different techniques becomes a crucial challenge. These algorithms are categorized as follows

1. Histogram shape-based techniques (in which the smoothed histogram's peaks, valleys, curvatures, etc. are examined)

2. Methods based on clustering (in which the grey level samples are represented as two Gaussian distributions or, alternatively, are grouped into two portions as background and foreground).
3. Object attribute-based techniques (wherein the number of objects, edges, and/or similarity between the segmented images and the grey level are examined) .[10]
4. Morphological processes.
5. Methods based on spatial relations (where global pixel correlation is taken into consideration using probability mass function models).
6. Color image segmentation: color images are segmented using the same methods as grayscale images. Researchers have applied fuzzy set theory, neural networks, clustering, and other soft computing approaches to each of these algorithms alone or in combination.

3. Literature Study

An algorithm for dividing grayscale pictures into separate areas with consistent texture and brightness was presented by Malik, in [6]. Concurrently, the changes in texture and contour are utilized as clues. Textons are used to examine texture, whilst contours are handled within the intervening contour framework. The image is partitioned into areas of coherent texture and brightness using the normalized cuts paradigm from spectral graph theory. For comparison, the ground truth evaluation was taken into account.

Edge detection is utilized for segmentation by Konishi in [7] they define edge detection as statistical inference. Data are used to fuel this statistical edge detection. Here, using pre-segmented images, the probability distributions of the filter responses are learned conditioned on whether they are evaluated on or off an edge..

The performance is evaluated using Receiver Operator Characteristic (ROC) curves, taking into account the ground facts of the pictures. This method's primary drawback is that it applies to one image dataset after learning from pre-segmented images on another. An algorithm was presented by Liang and colleagues [8] for edge detection in noisy pictures. Based on their gray values, pixels are categorized as fuzzy sets in this instance. Although the suggested approach is substantially faster, its performance is about comparable to that of the Canny algorithm. In this case, the evaluation of the ground truth and the evaluation parameter for comparison are disregarded.

Dong a, in [9] present an image segmentation technique for neural network-based color picture segmentation. The colors of the images are represented in a modified color space L*u*v in order to accurately assess the color difference. It makes use of neural networks and the color reduction and grouping techniques. The performance parameter and ground truth evaluation are not taken into account. Based on vector differences,

Evans and Liu[10] suggested a morphological gradient method for color edge identification. The method works well on computers and is easily adaptable to

various vector-valued images . The minimum vector dispersion (MVD) approach and the vector order statics (VOS) method are used to

compare the performance. The process is efficient in terms of computation and resistant to noise. SNR for noisy images is the performance evaluation parameter that is employed here. Boosted Edge Learning (BEL) is a supervised learning technique that Dollar and colleagues presented for edge and object boundary detection. Every point in the image has its own edge point chosen independently. For learning, it employs the Probabilistic Boosting Tree classification algorithm [11].

Konishi, are compared using the algorithm [8]. It compares using BSD pictures and is very scalable and flexible. A novel method for segmenting images based on a hierarchical and spatially varying mixing model was presented by Nikou , [11]. This model imposes a smoothness prior on the pixel labels, which are treated as random variables [12].On BSD pictures, a comparison is conducted between the spatially invariant finite mixture model (SVFMM) and the finite mixture model (FMM).

The Probabilistic Rand Index is the evaluation parameter (PRI).

Normalized probabilistic Rand Index (NPR) and Probabilistic Rand Index (PRI) parameter were proposed by Unnikrishnan and colleagues in 2007 [13] for the objective assessment and quantitative comparison of picture segmentation methods. It possesses the qualities listed below. In terms of unique segmentation cases, it does not degenerate. It doesn't assume anything about the information. To provide scores that are comparable between the algorithm and the photos, it is standardized.

A method for segmentation utilizing the Fusion of Histogram and K Means Cluster in Different Color Space was proposed by Max Mignotte in [14]. The suggested approach is quick to put into practice. The effectiveness is contrasted with compression-based texture merging (CTM), mean shift, and N-cuts techniques. On BSD images, it provides improved segmentation and PRI.

A method for segmentation by using picture contents to determine automatic thresholds was proposed by Yuan and et al. [15]. The automatic threshold is determined using a quad tree decomposition technique and a gradient of histogram. It takes into account the examination of ground truth and compares the algorithm with watershed region growth and extended gradient vector flow, or E-GVF. SNR is the performance evaluation metric applied to BSD pictures.

In [16], Ugarriza a introduced the concept of automatic picture segmentation by dynamic region expansion, utilizing color gradient detection and clustering techniques. When compared to BSD pictures, the method yields greater NPR and better segmentation. An image segmentation technique based on the JND (Just Noticeable Difference) histogram was proposed by Bhoyar and Kakde [17]. The CCH (conventional color histogram) is used to compare the approach. It produces superior outcomes to the CCH method. The algorithm yields better PSNR and PRI values and is faster. Ground truth is not taken into account here. Images from BSD are used for comparison.

A novel Bayesian model for image segmentation based on Gaussian mixture models (GMM) with spatial smoothness requirements was presented by Nikou and,etal [18].It compares the technique with N-cuts and the Gaussian blurring mean shift algorithm (GBMS) and employs ground truth evaluation. PSNR and PRI are the performance evaluation metrics applied to BSD pictures. The technique requires no parameters prior to training and is noise-resistant.

The JND (Just Noticeable Difference) histogram was used by Bhoyar and Kakde [19] to suggest a modified FCM (Fuzzy C-Means) technique to color image segmentation. For segmentation, the method is compared with the (fuzzy c-

means) FCM, which is quicker than FCM. Comparing the approach to FCM on BSD pictures, it yields higher PRI and PSNR ratios.

In order to produce a more dependable and accurate segmentation result, Max Mignotte [20]suggested a novel segmentation strategy based on a Markov random field (MRF) fusion model [20]. This approach intends to combine multiple segmentation results linked with simpler clustering models. It takes into account the ground truth. The algorithm is compared to N-cuts, CTM, mean shift, and CTM; on BSD pictures, it provides a better PRI than N-cuts, mean shift, and CTM.

An integrated method for contour detection and picture segmentation was presented by Arbelaez et al.[11] The segmentation algorithm and contour detector integrate several local cues to create a globalization framework based on spectral clustering. The contour detector's generic machinery converts any contour detector's output into a hierarchical area tree.

. The approach works better at segmenting photos than other methods have. On BSD images, it outperforms algorithms such as mean shift, Canny, N-cuts, and quad tree, which all have higher PRIs than the other algorithms. Setayesh , [8] introduced a particle swarm optimization (PSO) based method for noisy photos in [7]. It compares noisy images using PSNR and Pratt's Figure of Merit (PFOM), using a rectangle size with four and eight movement directions. When measured against the Canny algorithm, performance is superior, although Canny requires more computing power.

Mendhurwar.'s strategy for edge detection using independent component analysis is presented in [6]. When compared to the Canny method, the suggested strategy performs better in noisy environments. There is no consideration of ground truth image evaluations when comparing the performance based on PSNR. The approach can identify better edges in noisy environments and is resistant to noise.

Max Mie and Mirz[16] suggested a multiresolution model for picture segmentation based on multidimensional scaling. It makes use of the k-means clustering technique[19]. When compared to algorithms (CTM, SVGMM, Mean shift, N1-cutss, JND1, PCA1, G1BMS), the technique yields a higher PRI., and it outperforms recent methods for segmentation when ground truth evaluation of BSD images is taken into consideration. Under noise, the performance is not taken into account.

4. Image Segmentation Techniques

There are many approaches now in use for segmenting images . Shown Figure 1

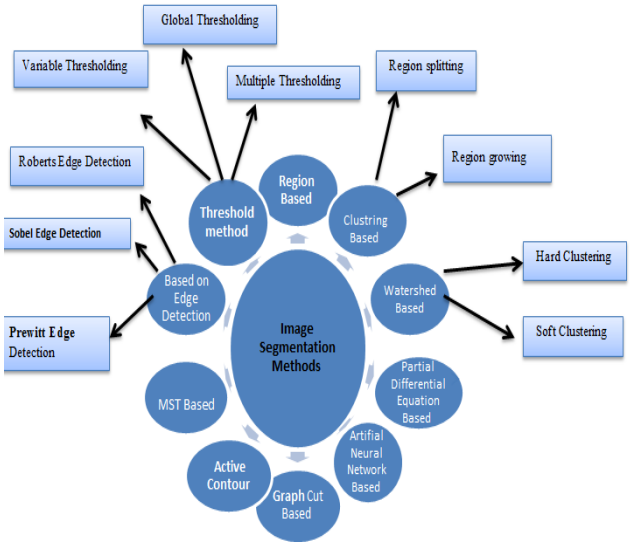

Figure [1]: Types of Segmentation Techniques

4.1Edge Based Segmentation Method

On their own, edge detection algorithms are sophisticated methods of image processing. Due to the fact that a single intensity value does not provide adequate information about edges, edge-based segmentation techniques rely on the quick changes in intensity values in images. Techniques for detecting edges identify edges where there are zero crossings in the second derivative or where the intensity of the first derivative is larger than a given threshold. In edge-based segmentation techniques, the necessary regions are

segmented by first detecting the edges and then joining them to construct object boundaries. Gray histograms and gradient-based approaches are the two fundamental edge-based segmentation techniques. One can use basic edge detection techniques such as Robert's operator, Canny operator, and Sobel operator, among others, to identify the edges. These techniques essentially produce a binary image. These structural methods rely on the identification of discontinuities [5].

The border between two places that have distinct characteristics is known as the "grey level." When an item is surrounded by a closed border that is visible and allows for the detection of image intensity, this is known as edge detection. Given that it describes the physical extent of an object, it plays a crucial role in pattern recognition and picture analysis. Edge detection methods are following:

1. Edge detection by Roberts The Roberts Edge Detection technique is used to find edges. This method was proposed to Lawerence Roberts in 1963.This method was the original edge detector. The Roberts operator measures a 2-D spatial gradient on an image in a straightforward and fast manner. Hence, it draws attention to areas with a strong spatial gradient, which frequently line up with edges. When the operator is used most frequently, both the input and the output are grayscale images. The estimated absolute magnitude of the input image's spatial gradient is represented by the pixel values at each location in the output. [4]

2. Detection of Sobel Edge Often referred to as a Sobel filter, the Sobel edge detector bears Irwin Sobel's name. The Sobel edge detector has two masks: a horizontal mask and a vertical mask. 3*3 metrices are typically utilized for these masks. Standard Sobel operators: each basic central gradient estimate for a 3 x 3 neighborhood is the vector sum of two orthogonal vectors [2]. A unit vector that indicates the direction of the derivative is multiplied by a directional derivative estimate for each orthogonal vector. The eight directional derivative vectors make up the vector sum of these straightforward gradient estimations. Accordingly, for a location on a Cartesian grid with eight neighbors that have the density values displayed[2],

a	b	c
d	e	f
g	h	i

Figure [2] Density values

3. Prewitt Edge Detection: In image processing, edge detection algorithms are employed in conjunction with Prewitt Edge Detector. Another name for it is the operator for discrete differentiation. It is employed in the computation of the picture intensity function's gradient. Applying a horizontal and vertical filter in order helps the Prewitt Edge filter identify edges. The final output is obtained by applying both filters to the image and adding them together. Both filters are simple convolution filters of the following type:[3]

1	1	1
0	0	0
-1	-1	-1

-1	0	1
-1	0	1
-1	0	1

Figure[3] :Horizontal Filter Vertical Filter

Table 1 :Summary of edge Based Segmentation Method	
Advantage	Disadvantage
- good for images with improved object contrast"	- unsuitable for incorrectly detected or excessively numerous edges

4.2. Region Based Segmentation Method

The techniques that divide an image into different regions with comparable features are known as region-based segmentation techniques. There are two primary strategies based on this concept [2].

1- Region growing methods :The segmentation techniques that divide an image into different regions according to the growth of seeds (first pixels) are known as region growing based techniques. These seeds can be chosen automatically (depending on the specific application) or manually (based on past knowledge). Then, the communication between pixels controls how seeds grow, and this may be blocked with the aid of past problem knowledge.

The fundamental eight-connection algorithmic steps of the region-growing approach are

Let s (M,N) be the binary image containing the seeds and p(M,N) be the original image that has to be segmented. Let "T" represent any predicate that needs to be examined at each position (M,N).

1. First of all. all the connected, components of „s1“ are eroded.

2.Compute a binary image PT. Where PT (M, N) = 1, if T(M, N) = True.

3Compute a binary image „q“, where q(x, y) = 1, if PT(M, N) = 1 and (M, N) is 8-connected to seed in „s“

2. Region splitting and merging methods: To segment an image into different areas, the region splitting and merging based segmentation methods use two fundamental techniques: splitting and merging. Splitting is the process of repeatedly splitting an image into areas with similar features, while merging is the process of uniting the nearby similar parts. This figure illustrates the quad tree-based division. The fundamental phases in the region-growing and merging method are [2].

Let "T" be the specific predicate and "p" be the original image.

1-First of all the R1 is equal to p.

2-Each region is divided into quadrants for which T (Ri) = False.

3- If for every region, T (Rj) = True, then merge adjacent regions Ri and Rj such that T (Ri U Rj) = True.

4-Continue step 3 until merging is not feasible.

Segmenting a comparable image into different regions is known as region-based segmentation. It is employed directly to ascertain the region. The picture pixels' grey values are used for partitioning.[5]. The following are the two fundamental methods of region-based segmentation:

Method of Region Growth Using predetermined criteria, region growth is a technique that aggregates pixels or subregions into bigger regions. The process of aggregating pixels begins with a collection of seed points, from which the associated regions expand by adding surrounding pixels with similar qualities (such as color, texture, shape, and/or grayscale) to each seed point. Splitting and Combining Regions In case of region splitting, the full image is taken as a single region and then this region is being break into a series of disjoint regions which are coherent with themselves. Regional consolidation is opposed Splitting a region. Following each split, a merging process compares neighboring regions and combines them. Beginning with small sections, it merges those with comparable properties (variance, grayscale, etc.).

Table 2 :Summary of Region Based Segmentation Method

Advantage	Disadvantage
- More noise-resistant and beneficial when defining similarity criteria is simple - These methods can accurately distinguish across regions that share the same characteristics.	- costly technique in terms of memory and time - Sensitivity, to. noise.

4.3. Clustering Based Segmentation Method

The approaches that divide a picture into clusters of pixels with similar properties are known as clustering-based techniques. The process of grouping data components into clusters so that those in the same cluster are more similar to one another than not is known as data clustering. The two main types of clustering techniques are partition-based and

hierarchical. The idea of trees serves as the foundation for the hierarchical approaches.

In this case, the internal nodes represent the clusters, while the root of the tree symbolizes the entire database. Conversely, the partition-based techniques minimize an objective function by iteratively applying optimization algorithms. There are a number of cluster-finding algorithms that lie between these two approaches. Fundamentally, there are two kinds of clustering [4].

1.Hard Clustering: This basic clustering method separates the image into a collection of clusters so that each pixel can only be a part of a single cluster. Stated differently, every pixel has the potential to be a part of exactly one cluster. These techniques make use of membership functions with values of either or 0, meaning that a given pixel may or may not belong to a given cluster. One k-means clustering based method called HCM is an illustration of a hard clustering based methodology. In this procedure, first of all the centers are computed then each pixel is assigned to nearest center. It places a strong emphasis on lowering inter-cluster equality and increasing intra-cluster similarity.

2. Soft clustering: This soft of clustering is more akin to natural clustering since noise makes precise division impossible in the real world. Soft clustering approaches are therefore most helpful for non-strict image segmentation. A good illustration of this kind of method is fuzzy c-means clustering.

This method divides pixels into clusters according to partial membership, meaning that a single pixel may be a part of multiple clusters, with the membership values indicating the degree of affiliation. Compared to previous strategies, this one is more adaptable [2].

Table 3 :Summary of clustering methods

Advantage	Disadvantage
- It makes use of the partial membership, which is better for completing the actual tasks. - Fuzzy is more beneficial for actual situations because it employs partial membership	-defining membership function is not simple - Determining the purpose of membership is a difficult task.

4.4. Methods Based on Watersheds

The topological interpretation notion is applied via the watershed-based approaches. The basins with holes in their minima where water spills are represented by the intensity in this case. The nearby basins combine when water reaches the basin's border. Dams are necessary to maintain the boundaries of the segmented region and to maintain the distinction between basins. Dilation is used in the construction of these dams. [15]. The gradient in the image is treated as a topographic surface by the watershed approaches. More gradient-containing pixels are shown as continuous boundaries

Table 4 :Summary of Watersheds Methods

Advantage	Disadvantage
- Findings show that the borders are continuous and more stable	- intricate gradient computation

4.5 Partial Differential Equation Based Segmentation Method

The partial differential equation based methods are the rapid methods of segmentation. These are suitable for applications that require speed. The two fundamental PDE techniques are convex non-quadratic variation restoration (which eliminates noise) and non-linear isotropic diffusion filter (which improves edges).

The PDE approach yields fuzzy borders and edges that can be adjusted with close operators. While the second order PDE approach is used to more accurately detect edges and boundaries, the fourth order PDE method is used to decrease noise from images

Table 5: Summary of Partial Differential Equation methods	
Advantage	Disadvantage
- fastest approach, ideal for tasks requiring quick response times	- increased intricacy of computation

4.6 Artificial Neural Network Based Method

For the goal of forming decisions, artificial neural network-based segmentation techniques mimic the human brain's learning mechanisms. These days, medical picture segmentation is the main use for this technique. The necessary image is separated from the background using it. A neural network consists of many interconnected nodes, with a specific weight assigned to each link. This approach does not rely on PDE. In this case, the problem is transformed into problems that neural networks can answer. The two fundamental components of this technology are feature extraction and neural network segmentation [2].

Table 6 :Summary of Artificial Neural Network Based Segmentation Method	
Advantage	Disadvantage
- No requirement to, write . intricate programs	- greater time wastage during training

4.7. Graph Cut-Based Methods

The basic idea behind graph cut-based approaches is to remove the edges connecting components G = (V,E,W) and divide it into related components Ai so that ∪Ai = V and Ai ∩ A j = ∅ component Ai. Using a graph cut-based technique, many well-defined global objective functions are optimized in an attempt to partition the image. A cut between two related components was proposed by Wu and Leahy [8] as follows: cut (A, B) = u∈A, v∈B, W (u, v). For digital picture segmentation, they suggested a technique called minimum cut, in which the shortest (K -1) cuts among all customizable cuts are chosen, and the matching edges are eliminated to form K-subgraph partitions. Wu and Leahy point out that over segmentation occurs when the lowest cut criteria encourage the development of multiple smaller segments with only a few isolated nodes. A new measure of ambition between two components was introduced by Shi and Malik [2] in order to get around these problems. Rather than looking at the combined weights of the two partial connectors, they compute the cut's cost as a percentage of the graph's total edge connections. Ncut(A,B) = cut(A,B) assoc(A,V) + cut(A,B) assoc(B,V) is the definition of this new measurement. Assoc(A,V) = _u∈A,t∈V W(u,t) is the total connections from nodes in A to all nodes in the graph, and assoc(B, V) is defined in a similar manner. The primary issue of dividing a digital image into K regions is reformulated as the issue of identifying the smallest (K − 1) Ncuts. Graph cut-based techniques typically produce good segment performance. They do take a lot of time, though. For instance, Shi and Malik [15] shown that proper reduction of Ncut is NP-hard for the Ncut approach. In order to tackle a generalized eigenvalue problem with complexity O(n3), where n is the number of pixels in a digital image, they consequently presented an approximation approach. The complexity is lowered to O (n(3/2)) if the graph is sparse, i.e., each node (pixel) is the only neighbor's connection being inside a tiny graph radius r (e.g., r < 10). To speed up Ncut, a number of multiscale approach-based experiments have been presented [11].

Table 7 :Summary of Graph Cut Based Segmentation Method	
Advantage	Disadvantage
- excellent segment outcomes.	- But they take a lot of time.

4.8 Active Contour-Based Methods

Active contour-based techniques work by fitting active contours toward the contours of objects in an image to determine their contours. Certain segmentation restrictions can be effectively addressed by certain contour-based segmentation techniques. Among these limitations are segmentation on an image with a very simple background and segmentation on an interactive image. An active contour model was employed in the technique described in [8] to identify items in a picture. This model was independent of the image's gradient. As a result, it may identify objects whose borders are determined by more than just the gradient.

When the image's background is uniformly simple, this approach can accurately determine the object's boundaries.

A local information-based model was proposed by Lankton and Tannenbaum [20]. Instead of using an energy function based on a global region, they used one based on a local region. They can produce precise segmentations of the items in a picture by selecting an appropriate localization scale.

An interactive approach based on a continuous-domain convex active contour model was presented by Nguyen et al. [18]. Their approach demonstrated resilience to varying initializations and user inputs. With only a few simple user inputs, their technology could generate boundary outlines that are accurate and smooth.

4.9 MST-Based Methods

An image is modeled as an MST using a number of techniques in the MST-based approach, and the segmentation process is carried out by dividing the tree into many subtrees [2].

The segmentation is carried out in reverse by the suggested methods in [9] and [14]. All of the vertices are initially thought of as segments. Then, in a greedy manner, two parts are chosen repeatedly to be considered for merger. Specifically, they defined internal difference of a segment S as the greatest edge of MST of S, and difference between two segments as the smallest weight linking any two segments. If the difference between two segments is equal to or less than the minimum of the internal difference between the two segments, then the two segments will be combined.

It was demonstrated by Felzenszwalb and Huttenlocher [9] that their technique could yield segments that are just the right amount of fine and coarse. Generally, MST-based algorithms are vulnerable to noise because only local information is employed to determine whether to split an MST [16] or merge two segments of these [9], [18]. These methods do have the advantage of being faster than graph cut-based methods [7].

The latest MST-based segmentation technique, for instance, can operate at O (n log n) complexity, where n is the number of image pixels, according to [9]. Their approach can execute in O (n) if the weights of edges are integer values (e.g., the difference in pixel intensity).

Table 8 :Summary of MST- Based Segmentation Method	
Advantage	Disadvantage
-quicker than techniques based on graph cuts	-.Computation is challenging - A predilection for dividing into equal parts.

4.10 Multiscale-Based Methods

Multiscale-based segmentation works have been studied, including [12]. In the portion before this one, we talked about a multiscale graph cut-based technique [8]. A probabilistic border detection method that integrates local and global data is presented by Arbelaez et al. [14]. In addition, they created hierarchical segmentation zones using a hierarchical segmentation technique. Modern precision is attained using this approach. The goal of Baatz and Schäpe [20] was to achieve excellent segmentation outcomes at various spatial scales. By combining local and global optimization methods, he was able to regulate the average segment size of an image by applying a scale parameter (SP). In order to determine whether or not to combine two items in a picture, he created a variety of similarity criteria. Results indicated that his segmentation approach may produce homogeneous image segments in an arbitrary scale. To determine the parameter SP in, Shaymaa et al. [2] suggested an automated parameterization technique. They chose the SP value based on information about local variance (LV). The matching SP value is chosen once the LV value reaches the ideal value. These two techniques [20] might produce good results when used to a geographically-themed image.

Table 9 :Summary of Multiscale Based Segmentation Method

Advantage
-distilled into four phases -Filtering with low pass -subsampling and 3 interpolation - distance learning. quicker than techniques based on graph cuts

4.11 Threshold Segmentation Method

The most used approach for segmenting images is the threshold method. It is used to differentiate foreground from background.

This technique transforms a greyscale image into a binary image [4]. All of the information required to determine the position and form of the objects is contained in the binary image. Binary image conversion is advantageous since it simplifies the data. The following are threshold techniques:

1. Global Thresholding The input image's intensity value should have two peak values in the global thresholding process, representing the signals from the background and objects, respectively. It indicates the amount of intensity difference between two peaks in a picture. Using a suitable threshold T, global thresholding is performed as follows: G(x, y) = 1 if f (x, y) > T = 0 if f (x, y) < T [5].
2. variable thresholding, we distinguish between the items in the foreground and background of an image by comparing the pixel intensities of each area. if T is able to vary throughout the image,

variable thresholding. If T is dependent on the vicinity of (x, y), thresholding can be local or regional. When T is a function of (x, y), adaptive thresholding is used. [5]

3. Multiple Thresholds A gray level image that has been multiplexed is divided into multiple different parts. It separates the image into several brightness zones and specifies many thresholds for the supplied image, which correspond to the backdrop and other objects. a, if f (x, y) > T2 g(x, y) = b, if T1 < f (x, y) ≤ T2 c, if f (x, y) ≤ T a, if f(x_1,y_1)>T2 are the many thresholding scenarios.

a, if f(x_1, y_1)>T2

$g(x_1, y_1) = b, if\ T1 < f(x_1, y_1) < T2$

c, if f$(x_1, y_1) < T$

Table 10 :Summary of image segmentationthresholding methods	
Advantage	Disadvantage
-In this way , the mathematical operation are easy and simple -No prior knowledge of image is required - Possibly applied in real time, applications. - The operation occurs at a faster pace.	-As for noise, it is more sensitive - Making the wrong decisions while choosing a threshold might lead to either over or under segmentation. - It does not function well in photos with large, level valleys or without any peaks.

5 .CONCLUSION

This paper discusses several picture segmentation approaches, which is a crucial subject in the fields of computer vision and image processing. Since these algorithms are now the subject of current research, they all have bright futures. Despite decades of research in this field, no single segmentation technique has been found to be universally approved or suitable for all types of images. The segmentation of images is influenced by a number of parameters, including texture, content, homogeneity, and continuity of the images' spatial features. The segmentation issue is still a serious topic in the domains of image processing and computer vision because of all the previously mentioned causes.

In the future, future studies can be conducted on this topic by finding better methods for the image segmentation process without changing the characteristics of the images

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