International Journal of Future Generation Communication and Networking
Vol. 13, No. 4, (2020), pp. 5069 - 5078

Analytical Study on Evaluation of Segmentation Quality of Image Comparing Various Techniques

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Abstract

Segmentation of the image is an essential processing stage for photographs and is utilized all over the world to evaluate the quality of an image. It has applications in many areas such as diagnostic applications, astronomy, traffic management, automated forensics, self-driven motor vehicles, satellite picture position etc. It has applications. In one or more characteristics, an image is divided into sub-regions. The basic stage for the study of and retrieval of images from images is the segmentation of images. Different methods for image processing and segmentation are among the most complex environments in which difficulty and reliability are the least. The segmentation of images is addressed and contrasted based on Area Based, Edge Detection, Thrust, clustering, Fuzzy Logic and Neural Network. These algorithms are based primarily on the similarity and discontinuity of two properties. Similarity-based approaches are referred to as regionally-based methods and destructive methods are referred to as minimal methods. A comparative review reveals that picture segmenting using a Marker Regulated Watershed Segmentation Algorithm can be effectively achieved.

Keywords: *Image Segmentation, Edge Detection, Fuzzy Logic, Neural Network, Region Based, Thresholding.*

1. Introduction

The general problem in today's period as we deal on computer vision is image recognition. It is an overarching perspective of itself to be taken into consideration. We must fragment the picture such that the machine is simpler to comprehend in order to interpret the image. Image segmentation includes the division of the image into different parts for more uses such as: the model of image interpretation, robotics, image processing, medical diagnostic applications, etc. Picture segmentation is the method of splitting an image into many parts to allow the portrayal of an image more coherent and more conveniently examined. The technique of segmentation transforms the complicated picture into the basic image in Figure 1.

ISSN: 2233-7857 IJFGCN

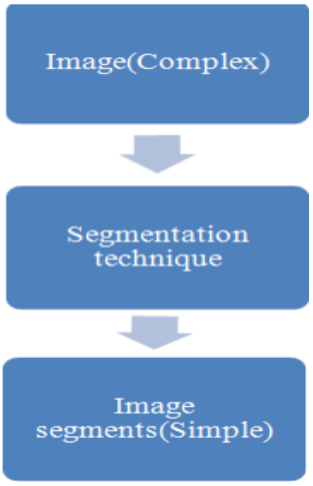

Fig1. Segmentation Technique

Picture segmentation ensures that pixels with the same etiquette share similar visual characteristics by allocated label for and pixel in the image. It simplifies the study of an image in the image processing tasks. Separation of pictures is achieved using several various methods. Our reason is to apply the nearly same definition as we human beings strive to use to appreciate the picture we see. In human perception, the abstract picture automatically becomes a colour, shape, shapes, forms etc. segmented into basic artifacts. The same thing is developed with the aid of the computer vision framework picture segmentation methods. On the basis of these characteristics, we should segregate the digital picture such that the process of image interpretation can be achieved in a clear and human way.

Based on these specified characteristics, the segmented results could be obtained from several image segmentation techniques. Picture segmentation applies to the optical picture classification into various divisions i. e. Pixels, pixelles in a defined region, in order to locate and distinguish artifacts and boundaries in a picture are identical according to certain homogeneity parameters, such as colour, strength or texture [1]. The use of a segmentation technique and the degree of segmentation are dictated by the specific form of image and features of the problem.

Literature Review

K. Jeevitha, A. Iyswariya, V. RamKumar, S. Mahaboob Basha, V. Praveen Kumar (2020) As machine technology has become improved, image processing technologies in a broad range of applications are becoming increasingly relevant. In the production of images, image segmentation plays a significant function. Picture segmentation refers to division of the image in various areas where in some features such as colour, strength or texture are similar and different. For the segmentation of photographs, different algorithms and techniques were created. This paper discusses and compiles those technology for the segmentation of pictures. This paper addresses the numerous segmentation technologies, including edge detection, thresholds, area dependent clustering, and segmentation of the picture of the neural network.

ISSN: 2233-7857 IJFGCN

Arti Taneja, Priya Ranjan and Amit Ujjlayan (2015) An effective image segmentation procedure needs to be accomplished for applications dependent on image such as target targeting, tumor identification, texture extraction. The separation of the picture into different regions that do not overlap the image is the segmentation of the image. Diverse segmentation techniques such as edge, threshold, field, clustering and neural networks participate in the productive image processing. With several algorithms, including active contour, level setting, clustering of FUZZy and K-means clustering, the segmentation method improved performance. The comprehensive survey of segments techniques includes the required improvement process, which encourages the segmentation of both strength and texture to obtain improved performance. The comparison of conventional strategies of image segmentation is seen.

Rozykumariet al. (2014) Proposed a Cluster-based pixel-based picture segmentation process. During this step the data collection, or claim the pixels are substituted for the same portion by clusters or pixels owing to the same replications and the clustering procedure is often known. The survey reveals that the key emphasis of the current strategies is on environments that are dynamic and therefore photos of mixed regions were not taken into account. The key reason behind the idea in the paper is clear and successful. In order to quickly detect complex artifacts, the edge preserving smoothing first filters the objects available on a digital image. Nevertheless, HSV can be used to efficiently segment color images.

Boren Li, Mao Pan and Zixing Wu (2012) Approach has been presented to minimize segmentation utilizing the watershed segmentation before and after processing. They also used more pre-processing information and combine the minimum redundant regions in post-processing. At the initial stage of the change, a gradient image is generated from the original photo, but even the gradient in texture is added. The gradient of the texture is extracted by means of a gray matrix. Then the two images fuse in order to create the final picture of the gradient. We use the combined area technology to eliminate small regions after the initial effects of segmentation

Wei Zhang and Daling Jiang (2011) A efficient morphological image segmentation technique was used to present watershed turn. But the segmentation causes and the noise generated in the picture. They used a watershed technology focused on labels, which minimized noise and segmentation. The first stage is bilateral filtering for image processing utilizing marker watershed segmentation, which is nice to reduce the slight impacts of noise on after-processing, and the usage of distance processing and image-processing shape recovery approach to ensure a more detailed positioning profile for next segmentation results. Finally, the transformation of the markers bases effectively eliminates the overflow dilemma and outlines the field more specifically.

Overview of Image Processing

The optical knowledge is a crucial information that the human brain understands, refines and processes. The optics was distributed to half the cerebral portion of the

ISSN: 2233-7857 IJFGCN

human brain (which process the information). There are several image recognition applications. In several areas we use picture processing such as medical field, picture sharpening and reconstruction, robot vision, pattern recognition, etc.

The sharpening and restoring of the picture apply to the image our digital will then handle to produce the required effects. Several operations such as zoom, blast, sharpening, edges identification, gray color conversion can be undertaken, and so on.

We may take it in self-driving cars as another example. It senses barriers. It's the normal way to process the picture by detecting the points or then measure the distance from here, depending on the image. It isn't that it is predicting explicitly, first the model is training on the basis of the training data it can easily anticipate. The latency is very low so that it can easily be identified.

Image Segmentation

The segmentation of the picture corresponds to the optical image segmentation process in N number of sections. The pictures are distributed in part at the premise of a collection of pixels in the area comparable with certain standards of homogeneity, such as texture, colour and strength. Picture segmentation distinguishes image f (x, y) from the continuous and nonempty subsets and makes greater data from these subsets. Picture segmentation application involves processing diagnostic photographs, satellite images, detection and classification of objects, police investigation, plant quality assurance, face recognition, the protection of the airport etc. Due to the value of the segmentation of the image, various algorithms have been suggested but the option of the algorithm is dependent on the kind of image and the problem form.

Segmentation Techniques

The two basic properties of intensity values are based on most image segmenting algorithms: discontinuity and similarity. The first solution is to segment the picture based on sudden strength shifts, such as the picture bordering. The second method is focused on predefined parameters for separating photos.

A. Edge Detection

Edge detection is the key stage for finding the edges of artifacts inside images throughout the segmentation process. The rim identification is accomplished by detecting abrupt variations or light discontinuities. It typically entails organizing discontinuity points into angled lines or curves. The gray histogram and gradient methods are the edge detection for image segmentation. Various operators, such as classic edge detectors, zero crossing detectors, Canny-edge detectors, Sobel, prewitt, Roberts Laplacian, Guassian(LoG) and color-end detectors etc. are engaged in edge detection.

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B. Threshold Based

The most popular technique for segmenting images is thresholding. Thresholding is a multilevel image segmentation technology, i.e., a proper threshold values are selected to partition the image pixels into multiple regions and distinguish artifacts from the background. OSTU thresholding, P-tile method, histogram-dependent technique, edge optimization technology, mean method, and visual technique are numerous thresholding methods suggested by different researchers.

C. Region Based Image Segmentation

Region-based segmentation is comparable to edge detection system and relatively easy and more noise-immune. Devise a picture of regions centered on a collection of predefined parameters into regions which are identical. Regional methods of segmentation are divided into three principal sections, i.e. rising area, separating region and merging region. Regional development is a regionally focused sequential technique scans and adds to broad areas based on predefined seed pixels, growth requirements and stop conditions for the neighboring pixels.

D. Image Segmentation Based on Clustering

In image segmentation, Clustering is an effective strategy. Several clustering methods are usable, including k means, adaptive k means, fuzzy c means, and improved fuzzy c means algorithm (IFCM). K-Means' algorithm is an unmonitored algorithm used to separate the desired region from the context. It separates or clusters the data into K-clusters.

E. Neural Network Based Image Segmentation

Neural networks are a set of nodes called neurons that are interconnected. Each neuron takes a piece of the input data, normally a pixel of the image, and uses a straightforward calculation, called the activation function. The numerical weight of each neuron determines its outcome. This outcome is transmitted to additional neural layers before a prediction for each input or pixel is produced at the end of the phase.

Comparison of Segmentation Techniques

Comparison of picture segments and their benefits are addressed and tabled along with limitations.

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Table 1 Comparison between Image Segmentation Techniques

Algorithm	Description	Advantages	Limitations
Segmentation by Clustering	Grouping of pixels having similar properties and defines the cluster values based on their visible intensities.	Works actually well on tiny datasets and generates admirable clusters.	a. Computation time is excessively large and also expensive. b.k-means is a distance-based algorithm. It is not suitable sometimes.
Segmentation by Edge Detection	Segmentation is done from end to end by identifying the boundaries.	Helps to retain gray tones in Edges and for good contrast images.	a. Difficult for low contrast images b.It is not suitable if edges are many.
Segmentation by Fuzzy Logic	Ambiguity and manipulation in datasets can be done easily with Fuzzy Logic Algorithm.	Unsupervised and Fuzzy is better than K- means. Assemble very well.	a. Fuzzy membership determination is not very easy . b.Computational expensive
Segmentation by Neural Network	Nodes of Neural Network are used.	Training data set are used to solve difficult problems and to detect errors easily.	a. Training of data set consumes more time. b. Sometimes required over training.
Segmentation by Region Based	Separates the objects into different regions based on Morphological operations	Calculations are simple and operations are fast. It works well high contrast images.	a. Sometimes overlap of the grayscale pixel values faces difficult. b.It is good with implementation of Marker based.
Segmentation by Thresholding	Depends on the histogram and Threshold of an image.	A simple approach to adopt without prior knowledge of image..	a. Computational expensive. b.Not suitable for real time applications

From the above discussion, all segmentation algorithms are efficient and, depending on implementations in different fields, have their own limitations.

Results and Discussions

Figure 2 demonstrates the effects of image segmentation utilizing Marker-Controlled The initial gradient, gradient and Watershed Transformed gradient are seen in Figure 2(a), 2(b), 2(c), respectively. Then it has been noticed that segmentation can be minimized when the marker-controlled segmentation is introduced.

Figure 2: (a) Read the Image

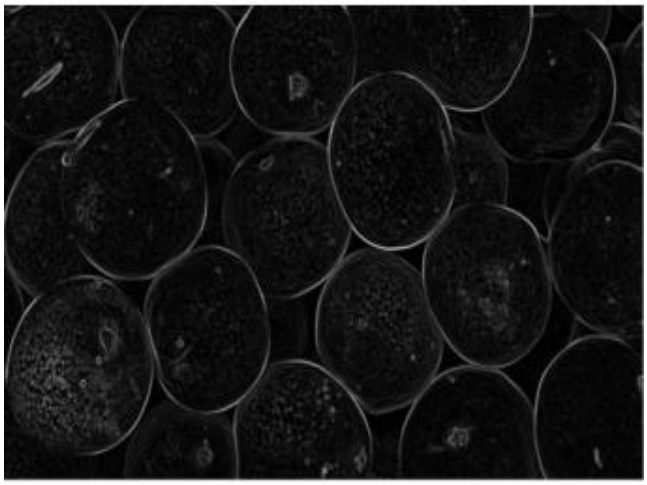

Figure 2: (b) Gradient Magnitude Image

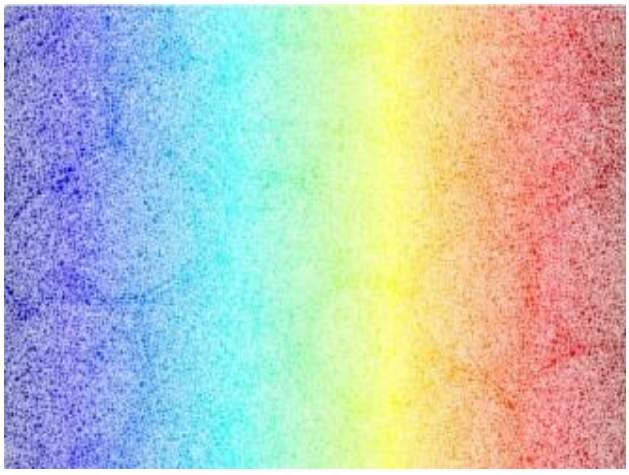

Figure 2: (c) Watershed Transformed Gradient Magnitudes Image

- **Watershed Segmentation Using the Distance Transforms**

The gap from each pixel of the object, which is black pixels to the nearest white pixel, converts a binary image. Just two gray degrees are 0 and 1 in binary pictures with 0 standing in black and 1 standing. In the topography of a binary picture surface, only a single catchment basin occurs as two black blobs are joined together. In this article the gap is converted along with the cylindrical edge detector in order to ready the picture for watershed segmentation. By using Distance Transformation in morphological water changes, the current edge sensing operators such as Prewitt, Robert, Canny and LoG help to segmente the picture. The typical watershed segmentation is implemented to detect boundaries that are smoother, more pointed and sharper with abundant details on the edges of the boundary. In addition, the Canny Edge operator more efficiently filters the noise in watershed segmentation through Distance Transform than the Sobel, LoG and other conventional operators. It has been noticed that Canny Edge is more effective with a distance transforming approach for edge segmentation detection.

ISSN: 2233-7857 IJFGCN

The Steps to Be Followed Includes

Step 1: Read the Image

Step 2: Convert it to Binary

Step 3: Find complement of Binary image and apply distance transform.

- **Watershed Segmentation Using Gradients**

The gradient magnitude will then be used to prepare a gray-scale picture for segmentation before utilizing the Watershed transformation. The Morphological Gradient Picture with the smoothed image may be used with expansion and erosion coupled with the image subtraction. Dilation and erosion thicken and diminish the regions in a picture. In Watershed separation, morphological gradient-based segmentation is implemented by restoration, opening and closing. Reconstruction operators then re-structure a gradient picture under which a lot of high-value gradient pixels have to be preserved and few low-value gradient pixels deleted. Thus, enhanced gradient algorithm is implemented to rebuild a picture which does not totally eradicate but over segmentation. It keeps clearly the location of the outlines of the area. The measures to be taken are

Phase 1: Picture Read

Phase 2: Use the magnitude of the gradient as the segmentation

Phase 3: The gradient transition ends in segmentation Watershed transformation

Phase 4: Smooth Watershed gradient picture transition eliminates segmentation, not entirely

- **Watershed Segmentation Using Marker-Controlled**

A strong and scalable approach was shown for fragments of artifacts with a closed contour, in which the borders are represented as ridges, by the marker-controlled watershed segmentation. A binary illustration composed of either single marker points or bigger marker areas, with each connected marker positioned inside an item of concern, is the marker picture used for water show segmentation. Each initial marker has a special connection with a particular area of the watershed and thus is equivalent to the final number of regions of the watershed. Following segmentation, each entity is isolated from its neighbour. The bounds of the water shed regions are organized on the desired ridges. Markers may be chosen manually or automatically, although high-performance assessments also automatically use markers to save time and money. The measures to be taken are

Phase 1: Read the picture of the gradient and apply the reconstruction closing and opening feature

Phase 2: Regional gradient absolute Maximum

Phase 3: Foreground Entity Computation

Phase 4: Context Objects Compute

Phase 5: Using Segmentation Function compute the Watershed Transform.

Phase 6: View the result

Conclusion

Several essential strategies are checked and summarized for the segmentation of pictures. It addresses and contrasts algorithms like K-means, Canny Edge Detection, C-means of Fuzzy, Neural Network, Watershed morphology, Otsu Thresholding techniques. Any of the new picture segmentation works are discussed. Through studying these approaches on an individual level, it is assumed that the morphological segmentation of the Marker-Controlled Watershed is superior. The Marker Regulated Watershed Segmentation helps solve and produce segmentation with decreased segmentation over segmentation over segmentation. When implemented by distance and magnitude operations, it generates the required performance. As there is no universally agreed methodology for Image Segmentation, it is a strong suggestion that a Managed Watershed Segmentation Algorithm can best be used to segment the processes of medical image processing to properly incorporate.

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ISSN: 2233-7857 IJFGCN