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Research Article

Various Image Segmentation Methods For Desktop And Mobile Devices

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ABSTRACT

Image segmentation serves as a focal point of exploration for numerous researchers in the field of computer vision. Image segmentation means partitioning an image in segments and assigns a label to every segment. The main idea behind image segmentation is to make image simpler for further processing. This chapter presents various image segmentation algorithms for desktop and mobile devices. With its numerous application in medical field such as tumor detection, color blindness, kidney diseases, it is found, the evaluation parameters are varying with application domain. But, Segmentation processing time is one of the major evaluation parameter in image segmentation. On contrary, image segmentation ingredients i.e., texture, color, pixel intensity, histogram and threshold values etc. are important in image segmentation. After studying the literature, this study is more helpful for improving the existing segmentation algorithm or developing a new segmentation algorithm.

Keywords: Image segmentation, threshold, clustering, pixel intensity, texture, histogram.

1 Introduction

Now days, mobile phones are not only simple telephonic devices but also work like handy computers which are capable of performing complex, processor-intensive and memory operations. This transformation of simple mobile devices into smart phones is providing the new generation's wide range of communication and entertainment. For this purpose till now people require number of devices for various task of daily routine. The advancements in mobile phone industries and imaging, smart phones are capable in providing attractive medium at low cost for providing image-based services at a less price.

The work of Gonzalez and Woods (2002) for Segmentation in image processing is the area concerned with the evaluation and analysis of the digital images based on the problem domain and relevant knowledge base. Image pre-processing and image post-processing are two important processes in digital image processing. Image pre-processing, generally deals with the correction in or evaluation of the given image before using it for the desired purpose and image post-processing, handles the problems or evaluations related to the generated images.

Image segmentation principally entails identifying resemblances and disparities within a given image.This leads to form the various regions, that is, partitioning the given image based on some of the parameters, for example, pixel intensity, texture, color, histogram, pixel connectivity, etc. Generally, image segmentation has image as the I/O of this process is, mostly, the attributes related to the concerned image which later can be used for the desired purpose. Grey or color images are generally used in image segmentation. Various color spaces can be used to process the given color image. Image segmentation serves as the basic technique utilized across various domains in image processing, including pattern recognition, content-based image retrieval, facial recognition, object recognition, medical image processing, fault detection in industrial products, and more.The various methods of image segmentation are classified based on similarity & discontinuity properties. Discontinuity property method is also known as boundary based method similarity property method is known as region based methods (Sharma et al., 2012). Edge identification is used to pinpoint the limits of areas in brokenness techniques, while district based strategies section a picture into locales that fulfill predefined conditions, as demonstrated in Figure 1.

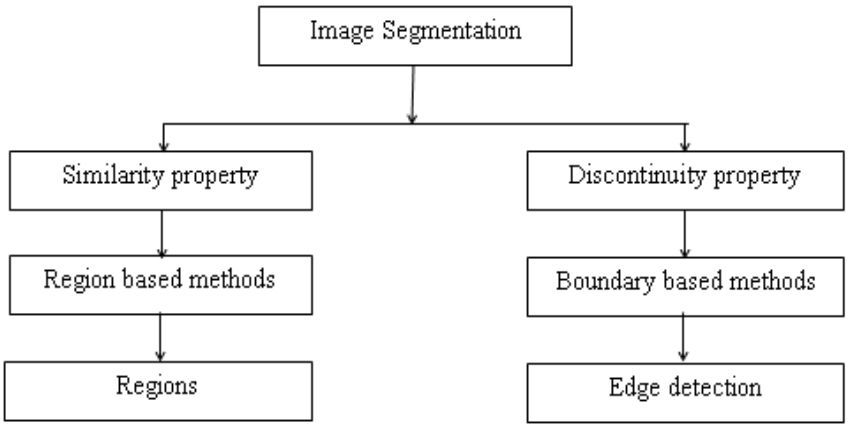

Fig. 1. Various approaches of Image Segmentation

Digital image processing(DIP) encompasses the application of various computer algorithms to digital images (Kaur & Kaur, 2014). These techniques serve two primary purposes: improving visual data for better human understanding, and managing image data for storage, representation, machine interpretation, and transmission. (Chowdhury et al., 2016). Significant stages in computerized picture handling,incorporate rebuilding, picture procurement, division, pressure, improvement, variety handling,, and recognition (Jaiswal & Tiwari, 2013). As noted by Saini and Arora (2014), image segmentation is essential for facilitating computer understanding of images.

2 Image Segmentatıon Methods For Desktop

Pre-processing and post-processing techniques are very important in digital image processing. Most of the research contribution exists in literature is concerned with these techniques. Generally two types of images-grey and color are handled by the various image segmentation approaches. Few of the research work allied to the proposed research work is analyses and presented here. Several review and survey papers for image segmentation on desktop PC are reported in literature, particularly, based on the category of the approaches. Few of the authors Fu and Mui (1981), Pal and Pal (1993), Zhang (1996), Freixenet et al. (2002), Ortiz and Oliver (2006), Zhang, Fritts and Goldman (2008) discuss the various techniques and their evaluations related to the various domains. Thresholding is the basic fundamental used in the image segmentation. Some of the other authors Weszka (1978), Sahoo et al. (1988), Chang et al. (2006) presents the study and comparison of the various thresholding techniques. The comparison and performance characterization of the various algorithms of image segmentation is presented in Ranade and Prewitt (1980),Hartley et al. (1982),Zhang and Gerbrands (1994),Zhang (1997) Southall et al.(2000) Pantofaru and Hebert (2005). Comparative analysis of segmentation algorithm for desktop is shown in Table 1.

Table 1. Comparative analysis of segmentation algorithms for desktop.

Ref	Concept	Assumption	Working	Remark
Pal (1993)	Fuzzy and non-fuzzy technique for color image segmentation	Not all procedures are overall around sensible for explicit sorts of pictures, nor are techniques by and large compelling for many pictures.	Index for qualitative evaluation is homogeneity, compactness, contrast, continuity, psycho-visual perception	Selection of segmentation technique depends on application &type of images
Freixenet et al. (2002)	Segmentation relying on region and boundary information.	Accuracy is evaluated and compared using synthetic and real images.	Quantitative assessment of region-based and boundary-based segmentation.	Multiresolution performance is based on simplicity & accuracy of the results
Zhang (2008)	Unsupervised objective evaluation methods	manually-segmented reference images does not require to compare with segmentations	Evaluation on the basis of subjective, system-level supervised and unsupervised evaluation.	Results of unsupervised segmentation evaluation are reasonably well
Sahoo et al. (1988)	Thresholding techniques including global & local thresholding	Group of digitized images from a portrait & natural scenes	The performance evaluation of automatic global thresholding methods utilizing uniformity and shape measures functions.	Tsai's and Otsu's moment-preserving methods are superior thresholding techniques.
Pantofaru (2005)	Graph-based segmentation &Mean shift-based segmentation algorithm	provides segmentation results with parameters on single image and multiple images with the same parameters	Evaluate the performance for accuracy and stability with parameter choice &image choice	Graph-based algorithm has less variability and slightly improved stability than mean shift-based algorithm

Apart from these, some other authors contribute to some typical techniques; Woods (2007) discuss feasibility to segment color images and the issues involved in designing genetic algorithms. Senthilkumaran and Rajesh (2009) discuss soft computing techniques are having various applications among them for the most part critical applications is edge area for picture division. The various authors discuss evaluation of method Kang, Yang and Liang (2009), Fuzzy clustering Irshad et al. (2010) is a process of allocating the membership levels, and further use these levels to assign data elements to clusters or data set, multi-objective optimization Bong and Mandava (2010) are realistic models for various complex optimization problems. The objectives conflict optimizing a particular solution is acceptable to only one objective whereas undesirable to other objectives, clustering

Thilagamani and Shanthi (2011), and agent based methods Mishra et al., (2011) and color based methods Hosea et al., (2011).

Other methods related to image segmentation are discussed in the literature. Li and Liu (2008), Zhang et al. (2009), Zhang and Hu (2008), Qin et al. (2010), and Krstinic et al. (2011) explore histogram-based approaches. Li and Liu (2008) propose image thresholding based on neighboring differential histograms. Zhang et al. (2009) present a non-uniform quantization-based color histogram technique. Zhang and Hu (2008) utilize Otsu's method for histogram analysis in image segmentation. Qin et al. (2010) employ cloud model-based histogram analysis for image segmentation, while Krstinic et al. (2011) introduce a two-pass histogram-based technique. Melas and Wilson (2002) have used the Markov random fields and Baysian for image segmentation. Unsupervised segmentation is discussed by Alvarado et al., (2002). Color image segmentation based on minimum spanning tree is carried out by Zhang and Yang (2006). Lan et al., (2009) proposed that Random walk based method is used in graph theory which converted into large-scale sparse linear equations for image segmentation. The equation output and the rate of iteration convergence depend on initial value selection as an input. But it has major drawback for segmentation of the huge scale image on random selection of initial value. Fuzzy-rough grid based Li and Wei (2009) approach discuss a shortest path segmentation algorithm. It takes into account the grid locations as well as the relationship between mesh grid function sizes, which validates the grid pixel values of comparable region of grid partition & the accuracy as a segmentation evaluation criteria. [118].

Senthilkumaran and Rajesh (2009) proposed Rough set theory approach that gives approximation of sets that leads to useful forms of granular computing. In different extensions of medical picture segmentation, this method substitutes a tolerance relation for the connection based on equivalency. Additional methods for image segmentation and contour detection are covered by (Maire, 2009). Banerjee et al., (2010) discuss Pixel processing based approach. Image segmentation on the basis of normalized cuts is described by Sun and He (2009), Shi and Malik (2000), Regentova et al., (2006). Huang et al., (2009) identified the distinct parts in the colour image using fuzzy logic in cluster creation. Maeda et al., (2008) proposed Fuzzy based hierarchical algorithm. ANN motivated approaches are developed and discussed by Feng et al., (2002), Meftah et al., (2010).

Grady and Schwartz (2006) focus on image partitioning, employing a graph-based approach utilizing the isoperimetric constant. Vanhamel et al. (2006) address color image segmentation using multi-scale watershed logic. Xu et al. (2007), for graph-spectral segmentation of synthetic aperture radar pictures, employ global image statistics. Wang et al. (2008) propose a graph theory-based algorithm for magnetic resonance brain images. Cao et al. (2008) introduce a method based on maximum weighted entropy of undirected graphs for image segmentation. Xu et al. (2009) tackle terrestrial point clouds segmentation by utilizing graph theory and automatic seed point selection. Ma et al. (2010) employ graph cuts, while Guo et al. (2010) utilize an optimal threshold model with graphs.To realize object based high resolution image segmentation the Multispectral high resolution image segmentation based on graph proposes Minimum Span Tree optimal theory (Cui and Zhang, 2010).It improved the edge-weight calculation by considering new band-weight and then edge based auto threshold select method works by changing the scale parameters on multi-scale image segmentation. In medical image segmentation extracting an object is the challenge. A segmentation approach combining watershed algorithm and graph theory Zhang and Cheng (2010) solves this problem up to some extent. In this combined algorithm the reconstruction of a floating-point active image is presented as mention image for watershed transform and then a graph theory based algorithm Grab Cut is used for better segmentation.

Adaptive model for remote sensing images is proposed by Hua et al., (2010) has definite analysis model and assessment standard for various commercial presentations. The image is interpreted by means of the graph model and by relating Ncut algorithm in graph theory. For better image segmentation the optimization is applied. As image segmentation is a multi-objective optimization problem discussed by Bong and Mandava (2010), various attempts are also reported in literature. Image segmentation is multi-objective problem such as minimize overall deviation and error rate of the classifier and maximize connectivity (Shirakawa & Nagao, 2009). Image segmentation includes numerous processes such as pattern representation and proximity (Saha & Bandyopadhyay, 2010), Guliashki et al., (2009). From this point of view, genetic algorithm discuss by Ramos and Muge (2000) and Maulik (2009) based attempts are also reported in literature. The critical and essential component of image analysis system is partitioning a digital image into pixels.

In image segmentation, clustering involves identifying sets of parallel images (Puzicha et al., 2000). Eick et al. (2004) propose supervised clustering, which incorporates a relevance feedback technique. Grira et al. (2005) discuss unsupervised clustering, including density-based clustering methods. Chen et al. (2008) address color image segmentation using K-means clustering, with the value of K automatically detected based on maxi-min initialization. Irani and Belaton (2009) examine simple K-means clustering. Li et al. (2009) propose a hybrid approach combining hierarchical and K-means clustering. Isa et al. (2009) describe adaptive fuzzy-based K-means clustering, while Li and Tian (2007) present multi-scale probabilistic image segmentation approaches.

Image segmentation is a multi-objective optimization problem, as it forms the regions on the basis of similarity or dissimilarity where one has to go for the more optimal region or cluster. Natural computing is the evolving area which deals with the non-classical optimization techniques. Work related to particle swarm optimization based Adaptive thresholding is used for the segmentation of the image by (Fu &Lei 2008, Jose &Jackson 2009).Image segmentation plays very important role in various image application domains. Few of the research

work related to the domains such as aerial image by Letournel et al., multi-spectral images by Chabrier et al., satellite images by Carleer et al., (2005), medical image by Crum et al., (2006) and object recognition by Pantofaru (2008) are also reported in literature.

The summary of various segmentation techniques such as Edge detection, thresholding, clustering, fuzzy and neural technique, are discussed by (Narkhede, 2013). Image segmentation is widely classified as semi-interactive & fully automatic approach. Various knowledge based methods for image segmentation are based on intensity, discontinuity, similarity, clustering and graph based methods to understand the principles and extraction of the section of interest. Khan and Ravi (2013) propose a comparative analysis of Threshold-Based Segmentation, region-based segmentation, and edge-based segmentation methods based on parameters including Region-Continuity, Computation Complexity,nature of the Output Image, Spatial Information, speed, Detection of Multiple objects, noise Immunity, Automaticity, and accuracy. However, image segmentation faces challenges due to factors such as homogeneity, spatial features of image continuity, texture, and content of the image (Dass et al., 2012).

The methods address texture detection using the current edge detection technique because texture is a characteristic that can only be found on edges (Hemalatha & Anouncia, 2016). Using fractional differential, Hemalatha and Anouncia (2017) provide work on unsupervised segmentation for remotely sensed pictures. Sharma and Virmani (2017) discuss an efficient decision support system for kidney illness detection that uses statistical features derived from renal ultrasound images. In order to increase clustering performance, Duggirala et al. (2016) introduce a novel hybridization of EM and K-means approaches that produces high-fitness and time-effective clustering outcomes.

3 Image Segmentatıon Methods For Mobıle Devıces

The various approaches for segmentation in mobile devices have been discussed. Varieties of domains are available for image segmentation on mobile devices but, no rigid solution is available for all types of domains such as mobile display and resolution of image. The objects which are segmented efficiently and extracted features on a structural background for classification & object recognition are discussed by (Hart et al., 2010). The methodology proposed by Liu et al., (2010) built on automatic boundary refinement used for to make the object cutout process more vigorous and suitable. The approach proposed by [91]Tasli and Ugur, (2011) is a communicating tool for generating stereo image from a mono image. The approach proposed by Park et al., (2011) is used for colour blind people having problem in detecting primary colours. The approach discuss by Kim and Jun, (2011) developed a real-time image processing application for Apple's iPhone 4 smartphone using the OpenCV library.

Nakagawa et al. (2011) introduce MOSIR, a mobile phone image retrieval system aiding in rapid image searching. Xiong et al. (2010) address the segmentation of hand pictures in unidentified backgrounds. Thirumaran et al. (2009) develop a Graphical password system as an alternative to conventional textual passwords for mobile devices. Faruk et al. (2010) propose image segmentation techniques for business cards using mobile phones. Gavilan et al. (2006) propose image retrieval with an effective segmentation method to extract significant regions in images. Liu et al. (2010) use the mean shift algorithm to concentrate on over-segmentation. Forlines and Balakrishnan (2009) present three image demonstration techniques aimed at enhancing visual search capabilities. The approach planned by Tom et al., (2005) is technologically advanced for image matching of pictures with definite boundary on mobile devices. Comparative analysis of segmentation algorithm for mobile device is presented in Table 2.

Table 2. Comparative study of segmentation algorithms on mobile devices.

Ref	Concept	Assumption	Working	Remark
Tasli and Ugur 2011[91]	The collaborative 2 Dimensional to 3 Dimensional image translation method for mobile devices allows users to seamlessly convert 2D images into 3D representations through interactive functionalities tailored for mobile platforms.	Logical neighborhood resemblance based methods keeps the energy for searching	The tool creates stereo images with all possible inequalities	non iterative choice for merging creates the method effective
Park et al., 2011[92]	Improved mobile device confusion line color transformation	Hue information is used to segment regions with similar color information grouped by the neighbourhood pixels	It divides the same hue using the region-growing technique.	To avoid confusion for CVDs, it suggests the best color information in all regions.
Kim and Jun, 2011[93]	Applications for AR (augmented reality) and image processing on smart mobile devices	Convenient user interface developed for limiting, contour detection and edge detection	A smartphone app and user interface for current picture processing	applied for multi-object argumentation and multi-marker finding
Nakagawa et al., (2011) [94]	segmentation and retrieving of images on mobile devices	Parallel images are found on basis of Edge & color layout	Use flash light as boundary approach to view images of dissimilar size & context	It provides flexibility to search similar images wholly or partly
Faruk et al., (2010) [95]	Series of mobile device photos of business cards taken with a camera	Extraction of text locales and sectioning them into characters	Text regions are extracted and corrected using skew correction technique	It organizes the individual segmented characters & preserves the layout
Liu et al., (2010) [96]	Quick and shared segmentation of images using discriminative clustering	Discriminative clustering comes after the initial over segmentation using the mean shift technique.	Compare &analyses strength & limitation of algorithm on mobile devices	Increasing speediness of segmentation considering precision

4 Exıstıng Methodologıes

Though, different approaches are reported in literature for image segmentation on mobile devices, here, we are discussing the prominent contributions and the methodologies reported therein.
The collaborative 2 Dimensional to 3 Dimensional image translation method for mobile devices allows users to seamlessly convert 2D images into 3D representations through interactive functionalities tailored for mobile platforms. (Tasli & Ugur, 2011) [91]:

The approach proposed is a communicating tool for generating stereo image from a simple image. Initially create organized image over segments on the basis of intensity, homogeneity and convexity limitation. Finally the over segmented regions are merged in a region growing way. This proposed approach is energy saving to search using the method of globally optimum cut.

Using Color Segmentation for Mobile Applications to apply enhanced Confusion Line Color Transform (Park et al., 2011)[92]:
The approach proposed is for color blind people who cannot detect primary colors. It uses hue information for segmentation of adjacent regions with similar pixels of color information. To evaluate the results low pass filter in the histogram technique is used for segmentation on mobile devices.
Gaussian multiscale aggregation concerned with to hand biometric segmentation in mobiles.(Sierra et al., 2011) [95]:
The approach proposed in related with the difficulty of segmentation of hand image in an unidentified background which requires a precise result in terms of hand isolation. The results evaluated by considering the precision and time parameters with the ability of being an appropriate solution for the problem of hand segmentation in contact-less environments.

Segment & Split-Image Based Authentication Techniques for Mobiles. (Thirumaran et al., 2009) [96].

The approach developed in image authentication is considered as an alternative to outdated textual password for mobile devices, which attains better tradeoff between usability and safety. In this paper, the authors enhanced the existing graphical password authentication techniques like selection-based authentication and click-based authentication and have proposed two new authentication techniques: segment based authentication and split-image based authentication. The segment based authentication uses constant color clustering algorithm to progress the speed and precision of the image segmentation.

Quick and shared segmentation of images using discriminative clustering (Liu et al., 2010) [99]:
The mean shift method is used in an over-segmentation strategy. Compared to previous methods that use graph cuts on over-segmented regions based on highest similarity, this approach requires less processing time and produces results of higher quality. When particular keywords for an object are unknown, information retrieval based on the object's visual appearance is useful.

5 Conclusion And Future Scope

In conclusion, this paper discuss about the different ways to divide images into parts for both computers and phones. Although many methods exist, none of them are perfect for every kind of image. Some techniques are used in medicine to find diseases like tumors or color blindness. But because there's no one-size-fits-all solution, these techniques can be combined with what we know about a specific area to make them better. There are challenges when doing this on phones, like the different types of pictures and the size of the screen. This chapter is a starting point for making new ways to split images on phones for lots of different uses. In the future, we want to make these methods faster and more accurate for phones.

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