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Review Article

Review on Image Object Extraction

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Abstract

Image is a set of objects and extracting these object components from image has been a continuous area of research since very long time. In image object extraction the main emphasis is on extracting each or focused objects from the image. Image object extraction techniques first detect the objects in images and in second step extract the detected objects from the original image. The object extraction techniques commonly use methods like edge detection, segmentation and background subtraction to name a few. With the advancements of research in various other fields of science and technology over the period of time, these techniques have found their application in many different areas i.e. Medical disease detection, satellite object extraction, image retrieval, objects recognition etc. This paper gives brief introduction to the image object extraction, discusses general method for image object extraction and provides detailed discussion on continual advancements and researches in the area of Image object extraction including the comparative study on the proposed techniques.

Keywords: *Object extraction, segmentation, classification, seed pixels, colour model, edge detection.*

1. Introduction

Today, Image-object extraction can be seen as one of the critical and challenging area in the image processing. Object extraction is the technique of extracting objects from the pre-processed image in such a way that within – class similarity is maximized and between – class similarity is minimized. In recent years the number of digital images has grown dramatically. In these images, the truly meaningful parts may be just a small proportion. The nontrivial contents, usually in the form of interesting objects, are sufficient to represent the semantic meanings in most cases and consequently play an important role in many image applications such as content-based retrieval. Therefore, many methods have been proposed to automatically extract interesting objects. Image Object extraction techniques are very useful for disease detection, object localization and object tracking. The method used for still image object extraction can also use for 3D image and video frames for the same purpose.

2. History

Object extraction from image in not a new area, it was discussed before five to six decade. In the initial phase the target object analyzed or extracted from gray level image and with the user interaction. After extraction of object the problem was to identify it (Smillie, s. F *et al*, 1966). And for specific pattern recognition the background pixels are compared with the foreground pixels (Woolfson, m. G.; vandelinde, v.d. *et al*, 1972). In the progressive phase the whole scene was analyzed in radiography image as well as the multispectral image data was extracted and classified into homogeneous objects group (Harlow, charles a.; eisenbeis, sharon a *et al*, 1973; Kettig, r. L.; landgrebe, d.a., *et al* , 1976). Afterwards edge detection's advantage came into the picture and by using that the boundary of object can be recognized and interesting foreground will be separated from background of image (Chin-Jung Huang *et al*, 2010). Now a day's easy technique for automatic (without user interaction) object extraction is a center of attraction for researcher (Chaobing Huang; Quan Liu; Shengsheng Yu, *et al*, 2009). In current scenario seed point selection can be done by using different color models (YanJie Zhang; Li, Xinghua, *et al*, 2011). Also so many integrated techniques came into the picture for object extraction (Chaobing Huang; Quan Liu; Xiaopeng Li, *et al*, 2010).

3. Application

Image Object extraction techniques are being used in various applications affecting many aspects of technology. Some of the major areas using image object extraction are:

3.1 Object tracking

In object tracking an object is followed to determine its movement relative to other objects. This is done through observing and comparing successive image frames,

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wherein position of centroid of the main object is measured in successive frames. Ex: Video object extraction with interactive image cut out and active search (Hayashi, T.; Watanabe, Y., *et al*, 2011).

3.2 Object identification

As name suggests, object identification in a digital image or video means finding and identifying different objects (e.g. Humans) in the same. One of the very important applications of object identification is computer vision. Ex: A framework for block based image authentication (Ghoshal, N.; Mandal, J.K.; Khamrui, A., *et al*, 2009) and Object detection by parts using appearance, structural and shape features (Li He; Hui Wang; Hong Zhang, *et al*, 2011).

3.3 Similarity measure

The concept of similarity is very important and this similarity measures are taken in the field of computer science too. This includes measuring similarity or its functions in real-valued function which computes the similarity between two objects. Ex: A New Approach of Image Similarity Calculation (Chin-Jung Huang, *et al*. 2010).

3.4 Disease detection

Disease detection, in a way, means spotting out the difference or fault. This is done through comparing an image with the original version of the same. Ex: Automatic Fundus Image Analysis System for Clinical Diagnosis of Glaucoma (Chih-Yin Ho; Tun-Wen Pai; Hao-Teng Chang; Hsin-Yi Chen, *et al*, 2011).

3.5 Satellite image object extraction

Constructions or building structures are identified in the pictures which are taken from the satellites. Post which, objects are extracted from the same. This is called as Satellite image object extraction.

4. General image object extraction process

In Object extraction technique there are some specific processes involved to get the resultant. Most of the proposed methods use a common process flow with improvements in some of the steps in this general process. The Fig. 1 shows the general process flow of image object extraction.

4.1 Preprocessing

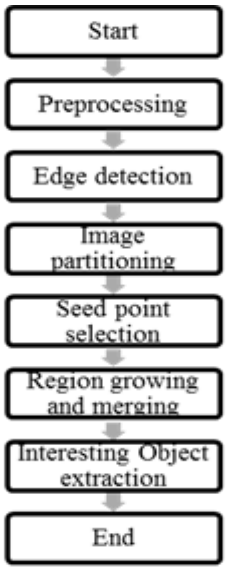
Preprocessing is an underlying part in any image processing technique. It relies on the unique technique demand.

4.2 Edge detection

For extracting any object from image one has to determine the range of object by defining the edge present into the still image.

4.3 Image partitioning

As name suggest the image is partitioned according to method, need and type of image. In this the main agent is to divide the image into small segment to make detection level easy. Segmentation and background subtraction are majorly used for image portioning.



Segmenting an image is a part of object extraction because for extracting any part from the image we first need to extract the different region or differentiate each and every region for further move (Yan Zhang; Haohao Song; Jian Gu; Shengyang Yu; Jie Yang, *et al*, 2010).

Background subtraction: Background subtraction is a technique in which simply the background is subtracted with the query image so that the only thing left is object. And the second thing is to differentiate the foreground pixels with the background pixel (Han Shung Cho; Kwanghyuk Bae; Kyu-Min Kyung; Seongyeong Jeong; Tae-Chan Kim, *et al*, 2013).

4.4 Seed point detection

Seed point selection is the first step for object extraction and can be done by following two types:

In user interactive category user needs to interact in between the run time for seed point selection, the part or point which is selected by user is further used as seed point (Yan Zhang; Haohao Song; Jian Gu; Shengyang Yu; Jie Yang, *et al*, 2010). In automatic seed selection techniques the method itself selects the seed point in the basis of peek points or variations (Chaobing Huang; Quan Liu; Shengsheng Yu, *et al*, 2009).

4.5 Region growing and merging

An initial set of small areas are iteratively merged according to similarity constraints. Start by choosing an arbitrary seed pixel and compare it with neighbouring

pixels. Region is grown from the seed pixel by adding in neighbouring pixels that are similar, increasing the size of the region. Region merging operations eliminate false boundaries and spurious regions by merging adjacent regions that belong to the same object (Chaobing Huang; Quan Liu; Xiaopeng Li, *et al*, 2010).

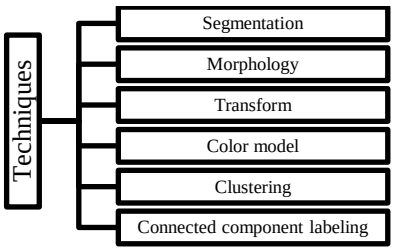
4.6 Interesting object extraction

Some application needs to detect each and every object from the image whereas some wants only specific kind of object like central object or the biggest object. Here are some examples given below:

In single object extraction methods main emphasis is only on detecting and extracting the single object according to the interest (Chaobing Huang; Quan Liu; Shengsheng Yu, *et al*, 2009). Whereas in multiple object extraction more than one or some times each and every object needs to be detected and extracted for further use (Paralic, M., *et al* 2012; Grana, C.; Borghesani, D.; Cucchiara, R., *et al* , 2009)

5. Classification of techniques used for image object extraction

Many techniques have been proposed by different researchers for efficient image object extraction. These techniques have been adopted in applications based on their performance and other characteristics suitable for the particular application. Following figure provides a classification of the proposed Image object extraction techniques based on the specific image processing methodologies adopted by these techniques. The Fig. 2 below shows the classification of object extraction technique with some example for each category.



These image processing methodologies are described in detail below

5.1 Segmentation

In segmentation whole image is portioned into small regions without losing any pixel information. Graph cut technique for image segmentation has been successfully used in image object extraction where the resultant of segmented image is used for course object extraction (Yan Zhang; Haohao Song; Jian Gu; Shengyang Yu; Jie Yang, *et al*, 2010).

5.2 Morphology

Morphology is the study of shape hence the morphology operation basically deals with the actual structure of object. In this process a structuring element is applied on the image to get the output with the operational formula like dilation, erosion, hit or miss, skeleton etc. Any specific kind of object can be extracted by using morphology operation like erosion, dilation etc. (Bar-Yosef, I.; Beckman, I.; Kedem, K.; Dinstein, I. , *et al*, 2005).

5.3 Transform

A function or operator that takes an image as its input and produces an image as its output. An image transform can be applied to an image to convert it from spatial domain to frequency domain and vice versa. Range image segmentation using randomized Hough transform (Yihong Ding; Xijian Ping; Min Hu; Dan Wang, *et al*, 2003) describes a technique in which by using range Hough transform image segmentation is done and the object is extracted from the image.

5.4 Clustering

The goal of clustering is to find a mapping of the archive images into classes (clusters) such that the set of classes provide essentially the same information about the image archive as the entire image-set collection. An image is segmented by using the K-means clustering (Alam, F.I.; Chowdhury, M.I.H.; Rabbani, M.R.; Bappee, F.K., *et al*, 2013), which is useful for multiple object extraction from image.

5.5 Color model

The human visual system can distinguish hundreds of thousands of different color shades and intensities, but only around 100 shades of grey. Therefore, in an image, a great deal of extra information may be contained in the color, and this extra information can then be used to simplify image analysis, e.g. Object identification and extraction based on color. Color model like HSV, HIS are used to detect the seed point or else for region growing for extracting the objects (Chaobing Huang; Quan Liu; Shengsheng Yu, *et al*, 2009; YanJie Zhang; Li, Xinghua, *et al* , 2011).

5.6 Connected component labeling

Connected components labeling scans an image and groups its pixels into components based on pixel connectivity, i.e. In this technique basically bins are created which consist of pixels with similar intensity and similar location address (strongly connected pixels). Once all groups have been determined, each pixel is labeled with a grey level or a color according to the component it was assigned to. (Paralic, M., *et al* 2012) and (Grana, C.; Borghesani, D.; Cucchiara, R., *et al* , 2009) uses this technique for connected object extraction. Extracting and labeling of various disjoint and connected components in an image is central to many automated image analysis application.

Table 1 Various proposed techniques for image object extraction

S.N	Paper	Methodology	Advantages	Disadvantages
1	Automatic object segmentation in images with low depth of field (Chee Sun Won; Kyungsuk Pyun; Gray, R.M., *et al*, 2002)	• Segmentation • Local variance image field • Block-wise MRF image model • blocks re-assignation • watershed algorithm	• More accurate segmentation than the multi resolution Wavelet-based segmentation method	• Applying the threshold method to the lVIF for the segmentation often yields blob-like errors in both focused and defocused regions
2	Extraction of specified objects from binary images using object based erosion transform (Bar-Yosef, I.; Beckman, I.; Kedem, K.; Dinstein, I. , *et al*, 2005)	• Erosion transform • Structuring element generation • Character Extraction • Validation measure • Structuring element adaptation	• Deals well with common problems of historical documents. • Correct extraction rate 96% is achieved.	• Only for binary image
3	SIOX: simple interactive object extraction in still images (Friedland, G.; Jantz, K.; Rojas, R., *et al*,2005)	• Color signatures. • Pixel assigned by a weighted nearest neighbor search. • Erode, dilate, and blur to remove artifacts. • Connected foreground components selection	• Its central data structure is efficient and not spatially bounded • classification copes well with noise	• Computation needs more time for noisy input. • Depends on the user provided tri-map. • Not possible to extract multiple objects at once
4	Image feature extraction - an overview (Kunaver, M.; Tasic, J.F., *et al*, 2005)	• The paper presents a short overview over many different techniques for feature extraction.		
5	A Practical approach to Boundary Accurate Multi Object Extraction from Still Images and Videos (Friedland, G.; Jantz, K.; Lenz, T.; Wiesel, F.; Rojas, R., *et al*, 2006)	• Manually selection of regions • Clustering the color space • Nearest neighbor search • Removal of artifacts • Find the connected components with high confidence • Color space and Construction of color signature	• Robust in the presence of noise • Can be applied to a variety of problems	• Color dependent
6	Image object extraction using Watershed transform and edge Region information (Aarti talreja, ekta udhwani, koustubh sinka; *et al*, 2011)	• Filtering • Converting to gray scale • Edge detection • Assign the edges as a marker • Watershed algorithm	• Simple method	• The difference map calculation is not satisfactory
7	Object oriented foreground image extraction (Yea-Shuan Huang; Fang-Hsuan Cheng, *et al*, 2007)	• Frame-based distinct pixel extraction, • Object detection, • Region-based foreground object extraction	• Accurate • Complete foreground object image	• Spends a longer processing time
8	Automatic central object extraction from color Image (Chaobing Huang; Quan Liu; Shengsheng Yu, *et al*, 2009)	• Homogeneity based on Global and the Local Information of HSV image • The high and low values of the e-image used for boundary extraction • Candidate object and background Seed points set • Region Growing and merging.	• Vary effective • Best result on natural color image • segmentation results are effective	• How to improve the method to make it effective to more image categories is left
9	Color image segmentation by seeded region growing and region merging (Chaobing Huang; Quan Liu; Xiaopeng Li, *et al*, 2010)	• Initially seed point generation: no edge and edge smoothness • Region criteria selection • Region growing • Region merging: Color based, size based.	• Experimental results show the effectiveness and efficiency of the method	• Seed point selection method is complex
10	A New Approach of Image Similarity Calculation (Chin-Jung Huang, *et al*, 2010)	• Division of picture into a limited number of grids • Hough Transform • Calculation of features • Express as an image numeric vector format	• Accuracy -> 80% as dividing picture into 100 grids. • Quantity of picture dividing grid is proportional to accuracy	• Need to consider both similitude effects

11	Interactive Object Extraction Using Hierarchical Graph Cuts (Yan Zhang; Haohao Song; Jian Gu; Shengyang Yu; Jie Yang, *et al*, 2010)	• Extended graph cut approach • The coarse-to-fine object segmentation: initial interactive rectangle defined. • The accurate boundary portrayal is performed at the finer scale. • A pyramid structure provides a framework for the processing, and the hierarchical structure ensures rapid boundary mapping between pyramid levels	• Effective • Convenience	
12	An Object Region Extraction Approach Based on Interest Pixel Detection and Inner Filling Strategy (Baohua Jin; Yong Gan; Yongquan Xia, *et al*, 2010)	• Interested pixels location • Comparison between the brightness of current pixel with the mean of neighbouring pixels • Grouping of the interested region • Simple filling approach.	• Feasible and valid	• Not applicable for complex background
13	Automatic Interesting Object Extraction From Images Using Complementary Saliency Maps (Haonan Yu, Jia Li2,3, Yonghong Tian, Tiejun Huang, *et al*, 2010)	• Frequency tuned saliency map • Estimate envelop by FCM, CCM and low threshold. • Skeleton calculation • Seed clustering by KD-tree • Smoothing	• Better result as compare to other saliency based object extraction technique with 0.88 precision and 0.89 recalls (authors result) • Break down the integrity problem.	• Restricted to single object.
14	Fast connected component labeling in binary images (Paralic, M., *et al* 2012)	• Capture image • YCbCr conversion • Skin detection • Component labeling • Sub-regions merging • Detected regions of interest	• Vary accurate result for binary image	• Overlapping regions of interest have to merged at boundary level
15	Foreground object extraction from multi-view images with layer quantization and boundary refinement (Woong Hee Kim; Jongwoon Hwang; Sikora, T., *et al*, 2011)	• Quantization of the disparity map with PSO algorithm • Refinement procedure • Window-based method	• Not dependent on disparity estimation methods • Accurate • Robust	• The boundary of the initial mask needs to be refined
16	A new object detection method in color image Processing (YanJie Zhang; Li, Xinghua, *et al*, 2011)	• Segmentation- Specifically, integrity and sensitivity • Hue intensity feature • Erosion and expanding operator	• Dependable background • Obtained the accurate target	• Object detection approach should be robust extremely, in Order to adapt to the situations that illumination changes.
17	Fast block based connected components Labeling (Grana, C.; Borghesani, D.; Cucchiara, R., *et al* , 2009)	• Input query image • Gray scale conversion • Edge detection • Seed point generation • 8 neighborhood pre-processing for region growing	• Can applied on different algorithm • Performance improvement	
18	Learning to extract focused object from Low DOF images (Hongliang Li; Ngan, K.N., *et al*, 2011)	• Ambiguity analysis in the description of focus object • Generating multiple segmentation for input image • Obtaining region representation (IVD, CVD ,GVD) • Training visual descriptor classifier • Cascade of classifier • Post processing	• Focused image is easily extracted with vary much accurate result	• Obtaining region representation and the flow of cascade classifier is difficult.
19	A Study on Development of Multiple Objects Extraction System Using Difference Image Edge Information (Na-Ra Shin* and Kicheon Hong, *et al*, 2011)	• Histogram calculation and edge of the frame image. • Object extraction: area extraction, edge enhancement, adaptive object area expansion • Labeling and boosting filter • Shadow removal and restoring the image.	• Easily extract multiple objects from the single image.	• Useful only when the background image present. • Mostly for video frame
20	Object Segmentation by an Automatic Edge Constrained Region Growing Technique (Susan, S.; Verma, O.P.; Swarup, J., *et al*, 2012)	• Image enhancement • Set the threshold value • Edge detection • Region growing and merging • Segmentation	• Efficient for single object detection	

6. Comparative study of image extraction techniques

Table 1 summarizes various proposed techniques for image object extraction with key characteristics including advantages and disadvantage:

Conclusions

In this paper, we have presented extensive survey of Image object extraction techniques. The general process of the Image object extraction has been described. The Image object extraction techniques have been classified and discussed in detail. Further, a detailed comparative study of the existing proposed techniques for object extraction has been carried out and merits and demerits have been summarized. We have identified and discussed various other areas where image object extraction techniques have found their applications.

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