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A Novel Approach to Image Segmentation

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Abstract— In some applications like, image recognition, compression and watermarking it is likely to be inefficient and unpractical to process the whole image. In that case it is necessary to segment the image before recognising, compressing or embedding some watermark. For this several image segmentation approaches are available to segment the image, to change the representation of the image or to simplify the image to make it more meaningful and easy to analyse. Image segmentation is the process of partitioning an image into multiple segments. This paper is describing a novel approach to image segmentation by performing some steps over the edges detected of all the objects present in the foreground or background. Also this approach will be very helpful in digital image watermarking application for more efficient embedding of watermark.

Keywords— Segmentation, techniques, edge detection, dilation and matlab functions.

I. INTRODUCTION

In the computer vision domain, image plays a very vital role for conveying information. By understanding images the information extracted from them can be used for various tasks like: authentication and identification of the owner, navigation of robots, extracting malign tissues from body scans, detection of cancerous cells, and identification of an airport from remote sensing data. Now there is a need of a method, with the help of which, we can understand images and extract information or objects, these objectives are fulfilled by image segmentation [1]. In computer vision, **image segmentation** is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse [2]. Segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up [3]. Some of the major applications of segmentation are Medical Imaging like locate tumors and other pathologies, measure tissue volumes, computer-guided surgery, etc. Various other fields where image segmentation is being used: locate objects in satellite images (roads, forests, etc.), face recognition, fingerprint recognition, traffic control systems, brake light detection, machine vision, etc.

This paper is organized as follows:

- Section 2 describes the previous segmentation techniques.
- Section 3 describes the proposed approach.
- Section 4 describes the experiment and result.
- Section 5 describes future work.

II. IMAGE SEGMENTATION TECHNIQUES

A great variety of image segmentation methods has been proposed in the past decades. Thousands of different segmentation techniques are present in the literature, but there is not a single method which can be considered good for different images, all methods are not equally good for a particular type of image.

Thus, in spite of several decades of research, there is no universally accepted method for image segmentation and therefore it remains a challenging problem in image processing and computer vision. Based on different technologies, image segmentation approaches are currently divided into following categories [1],

A. Threshold based segmentation: Input image f (i, j), output image g (i, j).

$$g(i,j) = \begin{cases} 1 & \text{for} \quad f(i,j) \geq \text{Threshold}\,, \\ 0 & \text{for} \quad f(i,j) < \text{Threshold}\,. \end{cases}$$

Histogram thresholding and slicing techniques are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.

Advantages:

- Simple technique, long time and more often used.
- Easy in hardware, intrinsically parallel.

Disadvantages:

- The threshold is a parameter which is difficult to adjust automatically in general.
- Works only for subclass of images in which objects are distinct from background in intensity.

Image segmentation by thresholding is a simple but powerful approach for segmenting images having light objects on dark background [4]. Thresholding technique is based on image space regions i.e. on characteristics of image [5]. Thresholding operation convert a multilevel image into a binary image i.e., it choose a proper threshold T, to divide image pixels into several regions and separate objects from background. Any pixel (x, y) is considered as a part of object if its intensity is greater than or equal to threshold value i.e., f(x, y) ≥T, else pixel belong to background [6, 7]. As per the selection of thresholding value, two types of thresholding methods are in existence [8], global and local thresholding.

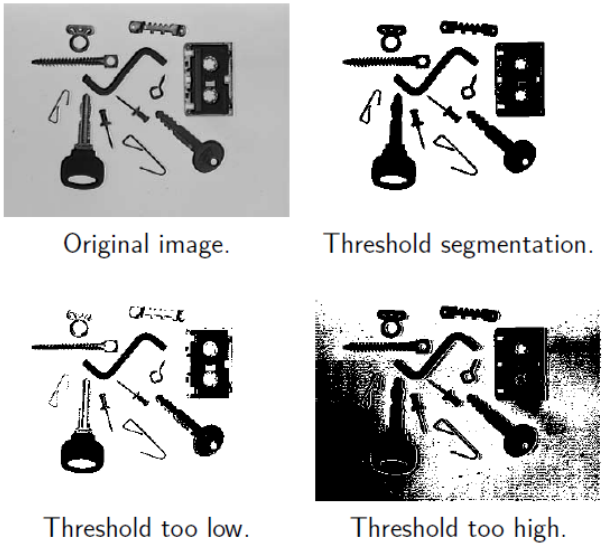

Fig 1. Threshold Influence [15]

B. Edge based segmentation: With this technique, detected edges in an image are assumed to represent object boundaries, and used to identify these objects. This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted [4, 9] and linked to form closed object boundaries. The result is a binary image [10]. Based on theory there are two main edge based segmentation methods-gray histogram and gradient based method [5].

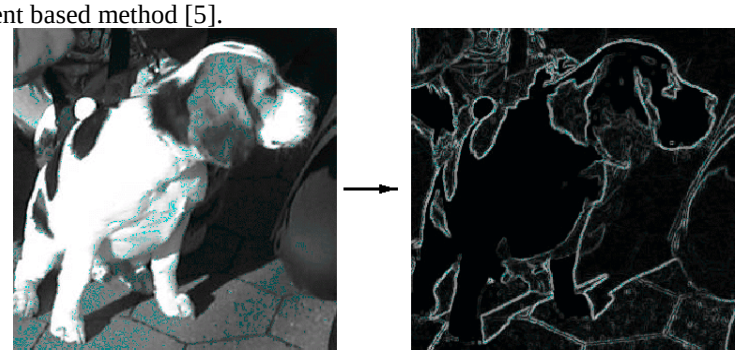

Fig 2. Edge based segmentation example [16]

C. Region based segmentation: Compared to edge detection method, segmentation algorithms based on region are relatively simple and more immune to noise [5, 11]. Edge based methods partition an image based on rapid changes in intensity near edges whereas region based methods, partition an image into regions that are similar according to a set of predefined criteria [4, 12]. Where an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique takes the opposite approach, by (*e.g.*) starting in the middle of an object and then "growing" outward until it meets the object boundaries [4].

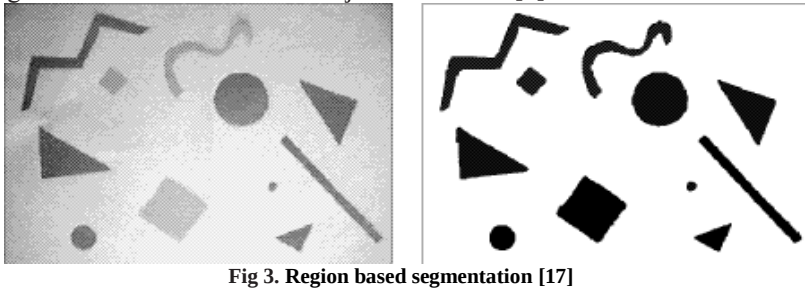

Fig 3. Region based segmentation [17]

D. Clustering Techniques: Although clustering is sometimes used as a synonym for (agglomerative) segmentation techniques, we use it here to denote techniques that are primarily used in exploratory data analysis of high-dimensional measurement patterns. In this context, clustering methods attempt to group together patterns that are similar in some

sense. This goal is very similar to what we are attempting to do when we segment an image, and indeed some clustering techniques can readily be applied for image segmentation [4].

Clustering is an unsupervised learning task, where one needs to identify a finite set of categories known as clusters to classify pixels [13]. Clustering use no training stages rather train themselves using available data. Clustering is mainly used when classes are known in advance. A similarity criteria is defined between pixels [14], and then similar pixels are grouped together to form clusters. The grouping of pixels into clusters is based on the principle of maximizing the intra class similarity and maximizing the inter class similarity. The quality of a clustering result depends on both the similarity measure used by the method and its implementation. Clustering algorithms are classified as hard clustering, k- means clustering, fuzzy clustering, etc.

E. Matching: When we know what an object we wish to identify in an image (approximately) looks like, we can use this knowledge to locate the object in an image. This approach to segmentation is called matching. If we want to locate an object in an image, and we have available an example of what it should look like (a *template*), we can find this object by matching the template to various image locations until we have found the object. The most straightforward way of determining whether a template 'fits' would be to place the template at a certain image location, and see whether the gray values of the template and the underlying image grey values all match. However, because there will generally be some differences between the image and template values because of noise and other artifacts, this is not a very practical method [4].

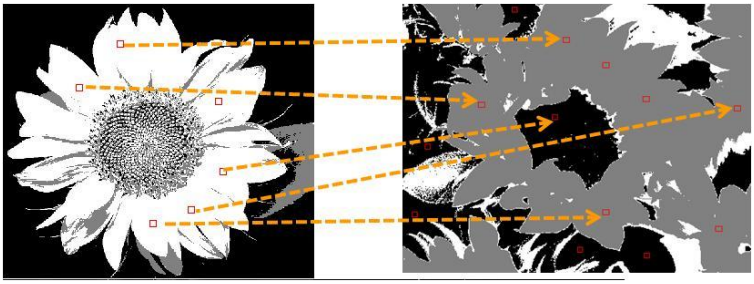

Fig 4. Matching [18]

III. PROPOSED APPROACH FOR IMAGE SEGMENTATION

The proposed approach for image segmentation is based on detecting the edges and then performing some steps over it.

1. Detect the edges of all the objects in the image.
2. Detected edges are then dilated.
3. The dilated part of the edges are solid filled which creates a new regular shape.
4. Again detect the edges of those newly created regular shapes.
5. Outline or mark the edges and show them as new segments.

IV. EXPERIMENT AND RESULT

The above proposed approach is implemented on matlab programming language. Some matlab functions are used to perform some operations like dilation. Otsu method of thresholding applied on the image to remove the noise. This approach is applied on more than 100 images of jpg, png, and bmp types of image formats. It is successful in more than 80% in segmenting the image. Its results are below shown,

Fig 5. Example 1

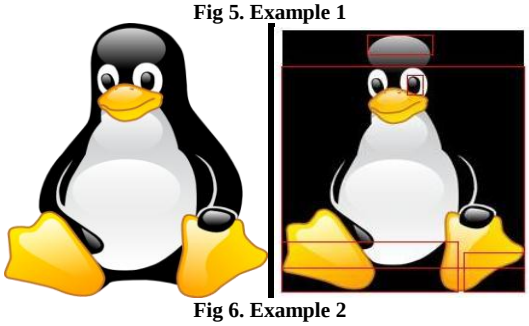

Fig 6. Example 2

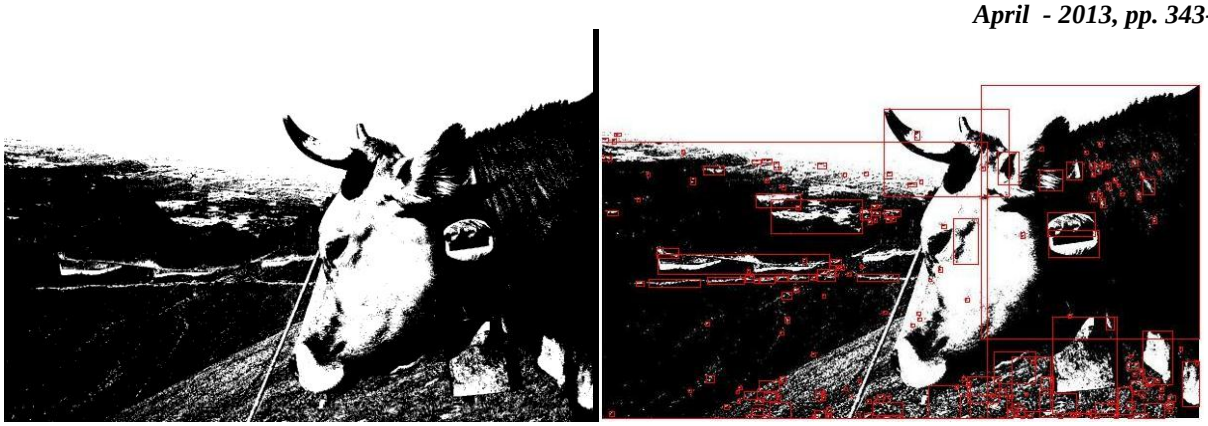

Fig 7. Example 3

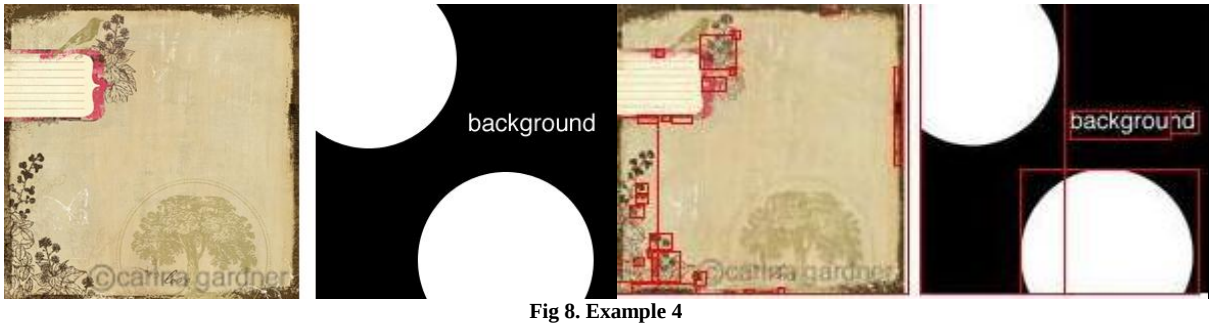

Fig 8. Example 4

Fig 9. Example 5

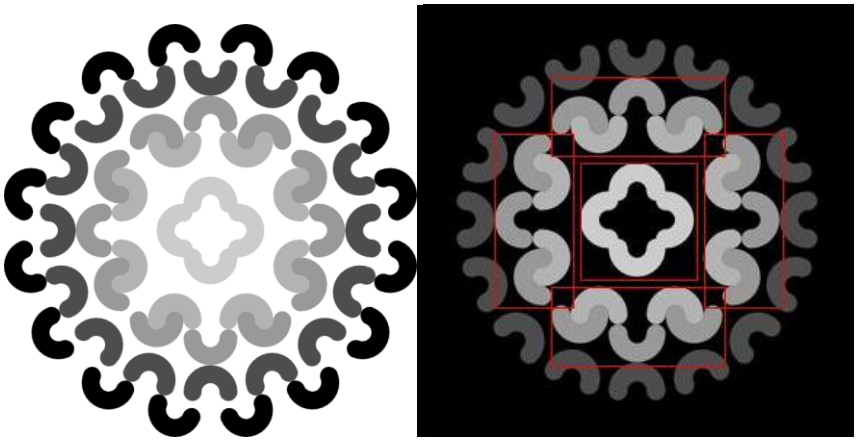

Fig 10. Example 6

V. FUTURE WORK

There are two key factors which allow for the use of a segmentation algorithm in a larger object detection system: correctness and stability. These two factors are used to evaluate segmentation approach. In the terms of the correctness

the approach is working on all the formats of images. It is evaluating the segments in all the images as shown in the above section but in the terms of stability it is not stable in the png format image. The constraint is that, the background is getting black after detecting the segments in the case of png image as shown in the Fig 6 and Fig 10 rest it is working fine in other images.

VI. CONCLUSION

In this paper a new approach to image segmentation is presented based on edge detection. Apart from it a brief overview is given to the various types of the segmentation. Image segmentation has a promising future as the universal segmentation algorithm and has become the focus of contemporary research. Homogeneity of images, spatial characteristics of the image continuity, texture, and image content is some of the factors that affect the image segmentation. So there is no such algorithm which is universally accepted.

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