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Experimental Analysis of Over Segmentation using Watershed Algorithm based Techniques

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ABSTRACT

Image Segmentation refers to partition an image into different regions that are homogenous with respect to one or several image features. Image analysis is an area of image processing that deals with techniques for extracting information from an image. In the simplest form, this task could be reading an address on a letter or finding defective parts on an assembly line. More complex image analysis systems measure quantitative information and use it to make a sophisticated decision such as trying to find images with a specified object in an image database .The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of regions that collectively covers the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristics or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to certain characteristics.

Keywords: Image Segmentation, Watershed Algorithm, applications, experimental analysis.

INTRODUCTION

Segmentation partitions an image into distinct regions containing each pixels with similar attributes. The success of image analysis depends on reliability of segmentation, but an accurate partitioning of an image is generally a very challenging problem. Segmentation techniques are either contextual or non-contextual. Segmentation is the process that split the image into various regions of different characteristics like colors, intensity and texture and extracts the interested object. Several general-purpose techniques and algorithms have been developed for image segmentation. Since there is no general solution to the image segmentation problem, these techniques often have to be combined with domain knowledge in order to effectively solve an image segmentation problem for a problem domain. Thus Image segmentation needs to be approached from a wide variety of perspectives. Major applications of image segmentation are in medical Imaging, face recognition, finger-print recognition.

Image segmentation is the process of partitioning a digital image into multiple segments. Segmentation is the process that split the image into various regions of various characteristics like colors, intensity and texture and extracts the interested object. Image segmentation is a significant and conceivably, the most difficult task in image processing. It is the process of separating the target/ object from the background or surroundings area by extracting outline of the target object. It is an important pre-processing step for most image analysis tasks. The general segmentation problem involves

the partitioning of a given image into a number of homogeneous segments (spatially connected graphs of pixels). Alternatively, segmentation can be considered as a pixel labeling process in the sense that all pixels that belong to the same homogeneous region are assigned the same label. Although it is a difficult problem, several algorithms have been proposed for its solution. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

Several general-purpose techniques and algorithms have been developed for image segmentation. Since there is no general solution to the image segmentation problem, these techniques often have to be combined with domain knowledge in order to effectively solve an image segmentation problem for a problem domain. Thus Image segmentation needs to be approached from a wide variety of perspectives. Various approaches of image segmentation are:

- Histogram Based Approaches
- Region Based Approaches
- Edge Based Approaches
- ANN Based segmentation
- Clustering Method segmentation

APPLICATIONS OF IMAGE SEGMENTATION

Various applications of image segmentation are:

Medical Imaging: Medical imaging techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Single Photon Emission Tomography (SPECT), Positron Emission Tomography (PET) and Ultrasound (US).

Face recognition: It is typically used in security systems.

Fingerprint recognition: Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints.

WATERSHED ALGORITHM

The watershed algorithm is a powerful and fast technique for both contour detection and region-based segmentation. In principle, watershed algorithm depends on ridges to perform a proper segmentation, a property that is often fulfilled in contour detection where the boundaries of the objects are expressed as ridges. For region-based segmentation, it is possible to convert the edges of the objects into ridges by calculating an edge map of the image. Watershed is normally implemented by region growing, based on a set of markers to avoid over segmentation.

Advantages of Watershed Transformation

Various advantages of watershed transformation are:

- Provides closed contours.
- Requires low computation time.
- Fast, simple and intuitive method.
- Able to produce a complete division of the image in separated regions

Drawbacks of Watershed Transform

Various disadvantages of watershed algorithm are:

Over-segmentation refers to over-cutting that occurs during the segmentation process. This means that fragments of the tissue of interest are omitted from the segmentation result, resulting in incompletely segmented tissue's of interest.

Under-segmentation, also commonly known as leaking, refers to the inclusion of unwanted regions in the segmentation result.

EXPERIMENMTAL ANALYSIS OF THE WATERSHED ALGORITHM BASED TECHNIQUES FOR THE AVOIDANCE OF OVER SEGMENTATION

Implementation results obtained after using direct watershed algorithm and watershed algorithm based techniques for the avoidance of over segmentation to pears image are as follows:

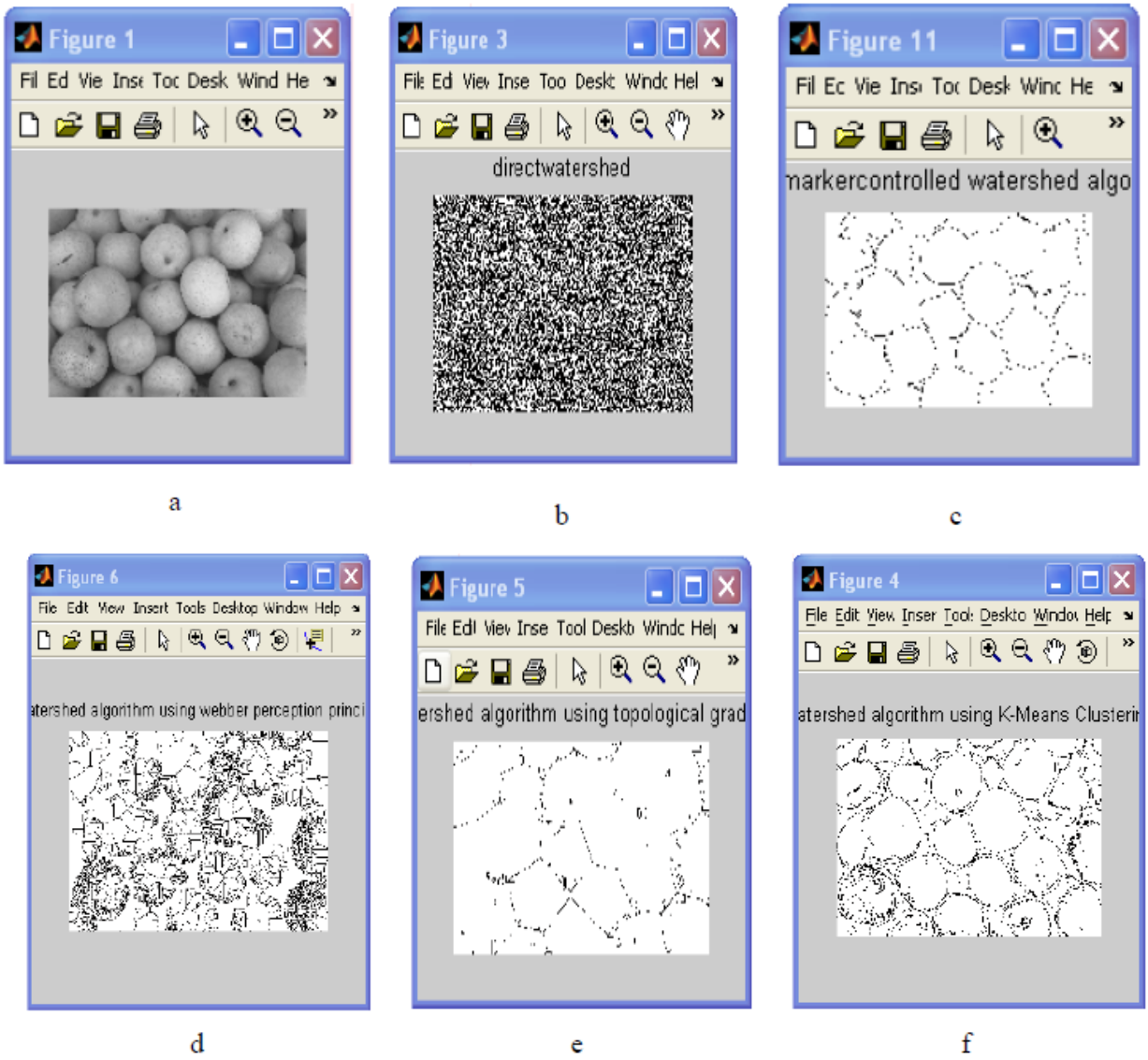

Figure 1 : Pears image (a) Input image, (b) Direct watershed algorithm image, (c) Marker controlled watershed algorithm image, (d) Watershed algorithm using webber perception principle image, (e) Watershed algorithm using topological gradient image, (f) Watershed algorithm using K-means clustering image.

Results obtained after superimposing the final segmented cancer cell image on the original image in case of all the watershed algorithm based techniques for the avoidance of over segmentation are as follows:

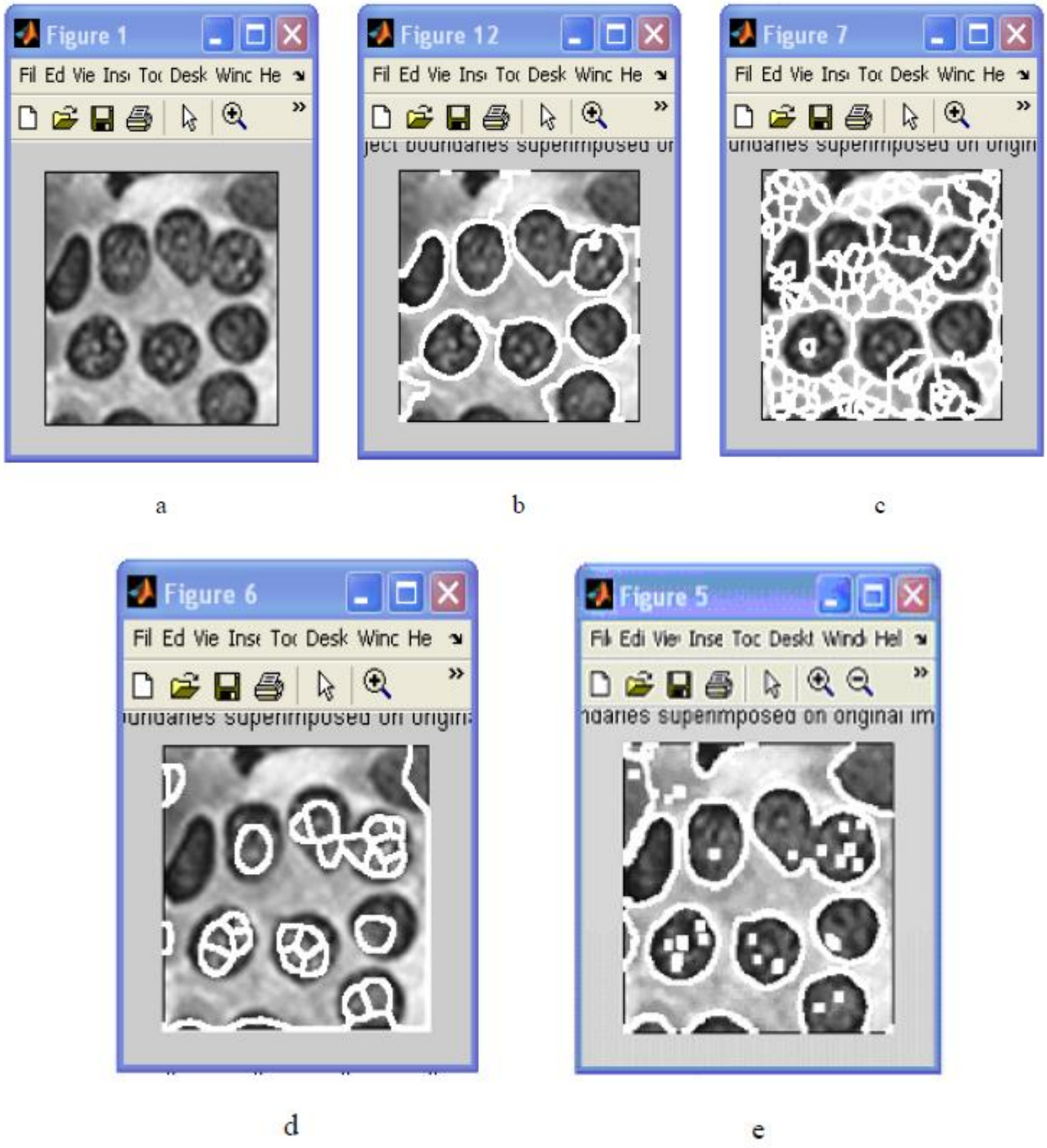

Figure 2 : Cancer cell image (a) Input image, (b) Marker controlled watershed algorithm image, (c) Watershed algorithm using webber perception principle image, (d) Watershed algorithm using topological gradient image, (e) Watershed algorithm using K-means clustering image

CONCLUSION

This paper presents the implementation and comparative analysis of watershed algorithm based techniques for the avoidance of over segmentation. One of the main objectives of segmentation algorithm is to precisely segment the image without under or over segmentation. The watershed algorithm is one of the popular region based segmentation technique and has an important drawback of over segmentation. Various preprocessing techniques to overcome this

over segmentation problem are marker controlled watershed algorithm, watershed algorithm using webber perception principle, watershed algorithm using topological gradient, watershed algorithm using K-means clustering.

FUTURE SCOPE

It is concluded from the results that watershed algorithm using K-means clustering gives the better segmentation results as compared with other watershed algorithm based techniques. Watershed algorithm using K-means clustering can be used to detect tumors. For future scope, it may possible that if we design some hybrid approach using K-means clustering and marker controlled watershed algorithm, this may give better segmentation results.

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