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An Approach for Classification of Images as Centerline or Contour Using Skeletonization Algorithms

Dr M Rama Bai[1], J SreeDevi[2]

Professor, IT, MGIT, Hyderabad, India [1]

Assistant Professor, CSE, MGIT, Hyderabad, India [2]

Abstract: Skeletonization is transformation of a component of a digital image into a subset of the original component. There are hundreds of publications on different aspects of these transformations. This paper reports contributions in this area with respect to properties of watershed, thinning and skeletonization algorithms. On application of these algorithms on different images, the results show that we can obtain characteristics of centerline or contour depending on the image. In this paper, it is proposed to apply morphological dilation operation with skeletonization to get results that are more effective. The algorithms are tested over many sample images. Hence it may be concluded that the development, choice and modification of such algorithms in practical applications are domain and task dependent, and there is no best method. By these experimental results, the images can be better classified by using properties of the resulting set in existing skeletonization algorithms for centerline or contour.

Keywords: skeletonization, watershed, thinning and shape simplification.

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to extract some useful information from it. Digital Processing techniques help in manipulation of the digital images by using computers. The raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display.

Shape recognition represents a procedure employed to extract information from acquired images. It is a very large field that includes human face recognition, handwriting recognition, finger – prints recognition, etc. Shape recognition means a classification and/or a description of the image contain. The classification consist in attribution of an unknown shape from the acquired image to a class from a set of predefined classes; the classifying operation produce an output image which represents a map of the objects of the scene in the image. In the new image, the values of the pixels represent actually the codes associated to corresponding classes. This classification uses mathematic methods of theoretic decisions or statistics, methods that are based on a few elements of the theory of statistic decisions[15].

Skeletonization and partitioning operations are well established approaches to summarizing shapes in digital image analysis. The skeleton of a shape is a lower-dimensional object that retains essential aspects of the shape's topology and geometry, typically via a centred curve but it may also incorporate medial surface patches. Partitioning, or shape decomposition, refers to the identification of simple regions that divide the shape into meaningful parts [14].

II. LITERATURE SURVEY

In image processing, segmentation is a basic problem in different fields for example, pattern recognition, scene analysis and image analysis. Image segmentation is the process of dividing images into regions according to its characteristic e.g., color and objects present in the images. These regions are sets of pixels and have some meaningful information about object. The result of image segmentation is in the form of images that are more meaningful, easier to understand and easier to analyze. In order to locate objects and boundaries in images feature extraction of object shape, optical density, and texture, surface visualization, image registration and compression image segmentation is used. Correct segmented results are very useful for the analysis, predication and diagnoses [1].

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This paper presents efficient way to classify digital images using existing skeletonization algorithms together with their resulting properties set.

Skeletonization

The skeleton can be produced in two main ways. The first is to use some kind of morphological thinning that successively erodes away pixels from the boundary (while preserving the end points of line segments) until no more thinning is possible, at which point what is left approximates the skeleton. The alternative method is to first calculate the distance transform of the image. The skeleton then lies along the *singularities* in the distance transform.

Thinning

Thinning is an image processing operation in which binary valued image regions are reduced to lines that approximate the center skeletons of the regions. It is usually required that the lines of the thinned result are connected for each single image region, then these can be used to infer shape and topology in the original image. A common use of thinning is in the preprocessing stage to facilitate higher level analysis and recognition for such applications as Optical Character Recognition, diagram understanding, fingerprint analysis, and feature detection for computer vision[3].

Watershed

The Watershed Transform is a unique technique for segmenting digital images that uses a type of region growing method based on an image gradient[14].

The Watershed Transform effectively combines elements from both the discontinuity and similarity based methods. Since its original development with grey-scale images, the Watershed Transform has been extended to a computationally efficient form (using FIFO queues) and applied to colour images. The main advantages of the Watershed method over other previously developed segmentation methods are

A. The resulting boundaries form closed and connected regions. Traditional edge based techniques most often form disconnected boundaries that need post-processing to produce closed regions.

B. The boundaries of the resulting regions always correspond to contours which appear in the image as obvious contours of objects. This is in contrast to split and merge methods where the first splitting is often a simple regular sectioning of the image leading sometimes to unstable results.

C. The union of all the regions forms the entire image region[13].

III. PROPOSED METHOD

A novel approach is proposed in this paper on shape recognition of an image. The proposed approach is presented in the Fig.1.

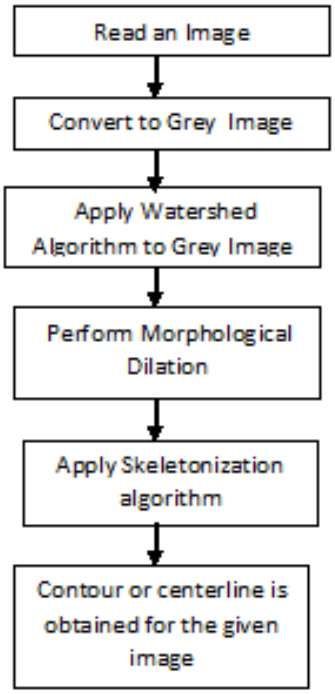

Fig 1: Proposed approach

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In this approach, Morphological Dilation is performed first and then Skeletonization algorithm is applied to the Water shed Image. The results are compared with the conventional thinning and skeletonization algorithms.

Thus information can be exchanged in the form of contour or centreline in a very efficient and effective way from the original colour image using properties of watershed, thinning and skeletonization algorithms.
Hence it may be concluded that the development, choice and modification of such algorithms in practical applications are domain and task dependent.

IV. EXPERIMENTAL RESULTS

The figure 2(a) is the original hand fracture color image and figure 5(a) is the fish image. The figure 2(b) and 5(b) are the watershed images which is obtained after converting the original image to grey image. The figure 2(c) is the contour obtained with the proposed method and figure 5(c) is the centerline which is obtained with the proposed method. The figure 3 and figure 6 are the results obtained after applying Thinning algorithm and figure 4 and figure 7 are the results obtained after applying Skeletonization algorithm.

Fig: 2 (a) Original Image

Proposed Method

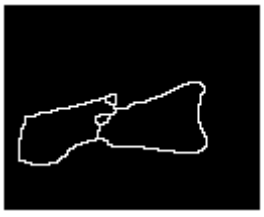

Fig: 2(b) Image after Watershed algorithm

Fig: 2(c) Image shows the detected contours

Fig:3 Image obtained by using Skeleton algorithm

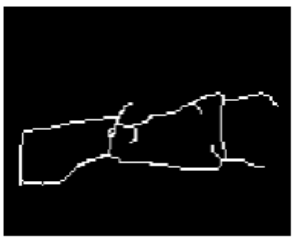

Fig: 4 Contour obtained by using Thinning algorithm

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Fig: 5 (a) Original Image

Proposed Method

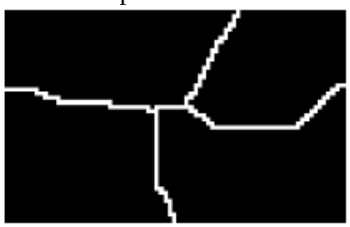

Fig: 5(b) Image after Watershed algorithm

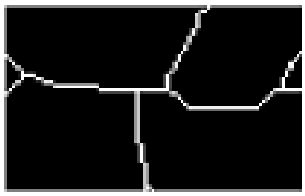

Fig: 5(c) Shows the centreline which is obtained after applying proposed method

Fig:6 Image obtained by using Skeleton algorithm

Fig:7 Image obtained by using Thinning algorithm

The Figure 3 and figure 4 are compared with the figure 2(c). The figure 6 and figure 7 are compared with the figure 5(c).

V. CONCLUSION

Skeletonization is transformation of a component of a digital image into a subset of the original component. There are different categories of skeletonization methods. One category was based on distance transforms. The result of distance skeleton was a specified subset of the transformed. In this method the original component could be reconstructed from the distance skeleton. Another category was defined by the thinning approaches. The result of skeletonization using

thinning algorithms was a connected set of digital curves or arcs. The motivational interest in skeletonization algorithms are the need to compute a reduced amount of data or to simplify the shape of an object in order to find features for recognition algorithms and classifications. Thinning algorithms was a very active area of research with its main focus on connectivity preserving methods allowing parallel implementation.

This paper presents efficient way to classify digital images using existing skeletonization algorithms together with their resulting properties set. The novelty of the method is depicted in this paper by its application on varied color and binary images. To achieve accurate contour and centerline, the proposed method applies morphological dilation operation with skeletonization to get results that are more effective. Therefore in order to carry out classification in a successful manner, the proposed method is very much advantageous and is well proved with the results. Thus information can be exchanged in the form of contour or centreline in a very efficient and effective way from the original colour image using properties of watershed, thinning and skeletonization algorithms. In the case of binary image it results in the generation of only centerline image. Thus, this paper compares and evaluate the different methods of the existing algorithms.

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BIOGRAPHIES

Dr. M. Rama Bai was awarded Ph.D. in Image Processing from Jawaharlal Nehru Technological University, Kakinada in 2012. She has presented and published 30 papers in various international Conferences and journals to her credit. She Published 2 book in International publication. She was also the jury member for many international conferences. Her research interests include Image processing, Neural Networks, Pattern Recognition, Database Management Systems, Data Mining, Computer networks and Network Security. She is a life member of ISTE & CSI.

J Sree Devi received her B.Tech (CSE) and M.Tech(SE) degree from JNTU, Hyderabad.She has presented and published 4 papers in various International journals and conferences. Her research interests include Digital Image Processing and Pattern Recognition.