FAST WATERSHED TRANSFORMATION

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ABSTRACT

The Fast watershed transform is an innovative approach that detects salient objects in an image. This transformation is entirely different from traditional watershed as it doesn't depend on mathematical morphology. The flooding of water in the image is efficiently simulated using the FIFO queue of pixels. It starts with sorting image pixel according to their intensity levels and stores them in their corresponding FIFO structure. This can be implemented using chain code algorithm. In addition it is faster than any other watershed algorithm. Integrating this fast watershed with energy based segmentation leads to a new segmentation method called fast water snakes.

Keywords: *First-In-First-Out, Chain Code algorithm, Fast Watershed.*

1. INTRODUCTION

Segmentation is a major challenge in image analysis, referring to the task of isolating objects in the image from the background, i.e., partitioning the image into disjoint regions, such that each region is homogeneous with respect to some property, such as grey value, intensity, color, texture. On average segmentation is used to extract meaningful objects and boundaries in images. Several approaches have been proposed, and they are mainly divided into two categories: energy-driven segmentation [1–7] and watershed-based [8–11].

Energy-driven segmentation normally consists of two parts, the data term and the regularize. The data term is close to the desired boundaries and the regularize controls the smoothness of the boundaries. Watershed segmentation [8–11] is a region growing technique belonging to the class of morphological operations. Traditionally the watershed techniques have been conducted without a smoothing term. The energy driven segmentation methods are mainly divided into two classes, contour based (snakes)and region-based. The contour based methods relay on strong edges. Recent progress allows a regularization of the watershed lines [18] with an energy-based watershed algorithm (water snakes). In Watershed it does not allow the characteristics of region boundaries to be included into the way that active contour algorithms do. So, over-segmentation is in the result.

Fast watershed transform is a simulation of the immersion analogy in a discrete space. It starts with sorting image pixels according to their intensity levels and stores them in their corresponding FIFO structures. Beginning with the FIFO containing pixel coordinates with the lowest intensity, it performs a queue-based simulation of immersion. This Fast watershed transformation algorithm is mainly depends on chain code. The traditional concept of chain code is first expanded into point-out chain code and point-in chain code. A chain code describes the boundary as a series of one pixel vector transitions at different orientations, only the starting point is defined explicitly. The time for computing fast watershed is reduced and the cost for computation is decreased.

2. RELATED WORK

Cremers [6] was introduced the gradient vector flow incorporating a global and external force which improved the capture range of their parametrical snake. Its one of the most well-know region-based method.

S.Beucher and C.Lantu'ejoul was introduced the watershed transformation as a tool for segmentation gray scale and is now used as a fundamental step in many powerful segmentation procedures.

L.Vincent and F.Meyer [14,15] was proposed an efficient watershed algorithm based on immersion simulations and also graph-based implementation of the hierarchies. Node corresponds to the catchment basins of the topographic surface. If two catchment basins are neighbours, their corresponding nodes are linked by an edge.

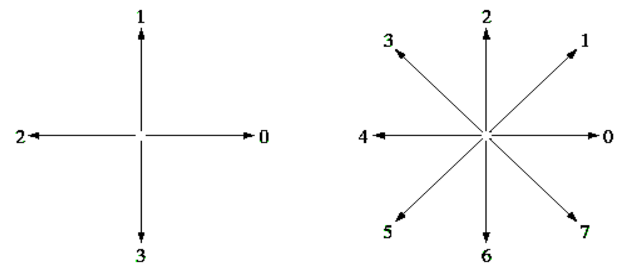
3. FAST WATERSHED TRANSFORM

Fast watershed transformation is employed which is entirely differing from watershed transform that depends on mathematical morphology. It reduces the over segmentation and under segmentation due to thick watershed lines, without the need of markers. The fast watershed transformation is a simulation of the immersion analogy in a discrete space. It is based on the sorting of image pixels according to their intensity levels and stores them in corresponding FIFO structure. This can be implemented using chain code algorithm.

3.1 CHAIN CODE

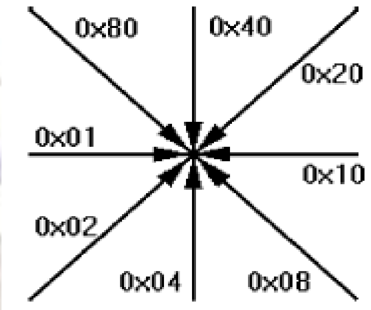
The chain code is used to represent an object boundary by a connected sequence of straight line segments of specified length and direction. A chain code is a more concise way of representing a list of points than a simple [(p1,q1),(p2,q2) .....]. A chain code describes the boundary as a series of one pixel vector transitions at different orientations, only the starting point is defined explicitly. Chain code is thought as representing the contour of the image. The number of neighbouring pixels depends upon the position of the pixel under consideration .The pixel present in the edges have only there neighbouring pixels. The rest of the pixels have eight neighbouring pixels.

Each code can be considered as the angular direction, in multiples of 45degree that we must move to go from one contour pixel to the next.

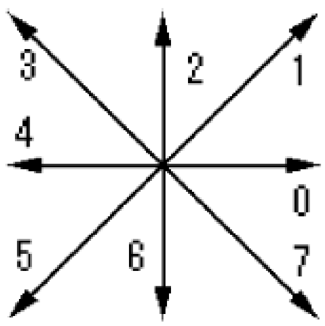


4–Directional and 8– Directional Chain Code

The pixels are directed by considering two terminologies: Point-in pixels and Point-out pixels. Point-out chain code is the directional code that current pixel points to. Point-in chain code is the directional code that neighbour pixel points to.

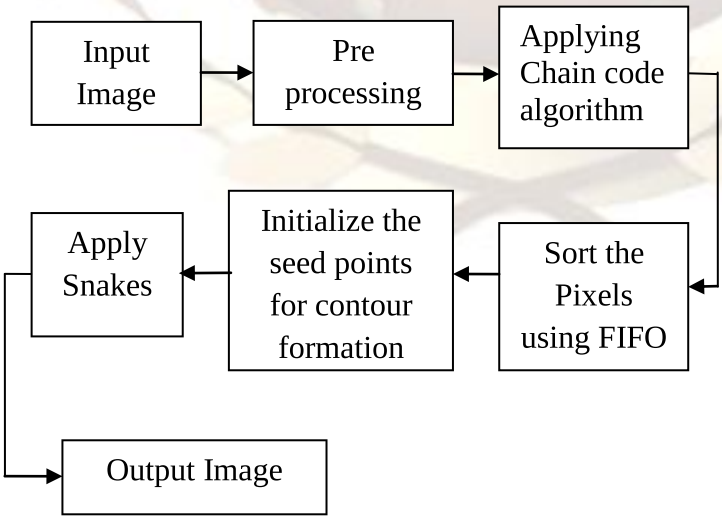


Point – In



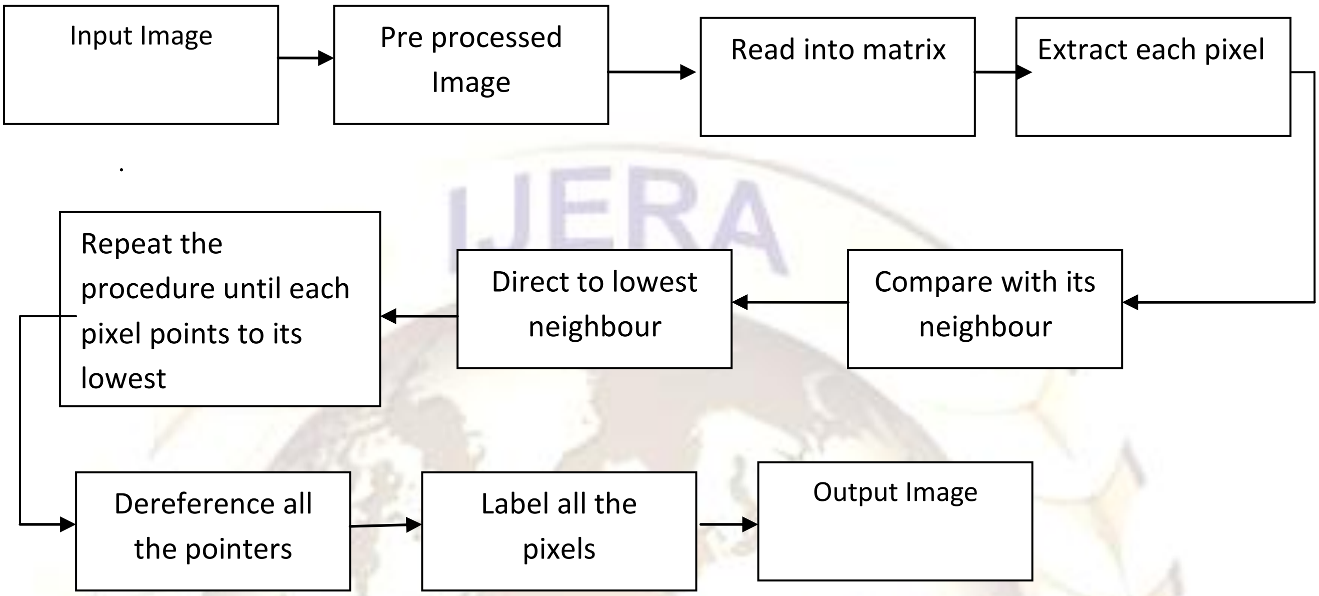
Point – Out

3.2 PROCESS FOR FAST WATERSHED TRANSFORM



3.3 FAST WATERSNAKES

Integrating the fast watershed with energy based segmentation leads to a new segmentation method called fast water snakes. Get the seed points from fast watershed transformation and then calculating the spine value. Next apply the gradient filtering and calculating the vector field. Finally segmented output can be obtained using the segmentation process.



3.4. CHAIN CODE ALGORITHM

1. Compare the present value x with all the neighbouring pixels and direct x to smallest value.

2. Compare x with neighbors and if any of the neighbour is "In-point Pixel" list them all and if any of them directs to lowest bound redirect the x to that neighbour.

Case [1] Apply FIFO in determining multiple neighbour directions.

Case [2] Incase of no such In-point neighbours, direct x to other neighbour of "Equal" value applying FIFO.

3. By repeat step 2, all the pixels on the image points to any one of the in-point pixel directly or indirectly.

4. A unique label is given to each pixel which points to same in Point.

5. Pointers for all pixels are dereferences, and labels are given to all the pixels.

4. EXPERIMENTAL RESULTS

With the help of this algorithm the object has been extracted from an image successfully. The proposed system has been implemented in matlab. The experimental results are shown below.

a)Original images

b) Extracted objects from corresponding original images

5. CONCLUSION

The Fast watershed algorithm introduced in this paper is extremely powerful compared to the existing ones. Not only it is often faster, but it also proves to be more accurate with regularization of watershed and furthermore, it turns to be very flexible. The examples of application which have been provided clearly illustrate the huge interest of the watershed transformation. Until now, its computation was so time consuming on conventional computers that only few people could actually use this transformation in practice. The present algorithm should now allow anyone to resort to watersheds for solving complex segmentation problems. In particular, more experiments are currently being carried on to evaluate the interest of watersheds on graphs with respect to image segmentation.

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