IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Volume-3, Issue-10 E-ISSN: 2347-2693

# An Effective Approach of Thinning for Morphological Features

Kapila Sharma
Assistent professor,Department of computer application
Sikkim Manipal University, Sikkim, India

www.ijcseonline.og

Received: Sep/28/2015 Revised: Oct/10/2015 Accepted: Oct /22/2015 Published: Oct /31/ 2015

***Abstract*—** Thinning is a challenging and important part while involvement with any image extraction process many works have been presented in this area, many thinning algorithms though have produced good results but still there needs a lot of improvement. Most of the algorithms based on thinning an image cannot justify the connectivity of various parts of the image. This paper presents algorithm for automated thinning of linear features by maintaining the integrity of pixels in order to maintain the connectedness. The connectivity of various pixels is achieved by traversing through the pixels and considering those pixels which have maximum number of neighbors. The iterative algorithm for thinning as presented in this paper takes the image into sections and represents each section as matrix to perform number of traversals. Thinning is an essential step of data compression useful in recognition and extraction of various morphological features from topographic sheets.

***Keywords*—** Thinning, Morphological features

## I. INTRODUCTION

Thinning plays a vital role as a preprocessing technique in image extraction process. Automated extraction and identification of morphological features is based on ridge features known as minutiae. Ridge features are useful for recognition of various linear features like rivers, water bodies etc. which are identified by lines and points. While extracting feature of interest from reference image or dataset the feature extracted is represented as a multivalued attribute, so there arises the need to reduce the information extracted into minimal information without eliminating the significant topological and geometric properties. Thin line representation of features makes the process of extraction and recognition of features easier and effective. Thinning is a morphological operation used in digital image processing for analysis of various shapes and sizes of binary images by removing selected foreground pixels. The basic objective of thinning is to simplify the extraction process by preserving the important information like shape and size of the image. This process is basically used to form skeletons of features of interest so that it can be represented using single pixel thickness. Skeletons of image enhance the image quality by Filtering the noise and removal of undesirable features. Thinning is mostly applied to binary images and produces skeleton binary image as output useful for many applications like document analysis, pattern recognition, image compression etc.

## II. RELATED WORK

| Ref No | Name of Paper | Method |
|---|---|---|
| [1] | A Novel Single Pass Thinning Algorithm | sequential algorithm which accomplishes thinning of digital pictures with the use of flag map and bit map together in order to decide the boundary pixel deletion and is limited to local removal criteria but does not reflect the global shape features |
| [2] | A simple and robust thinning algorithm on cell complexes | thinning algorithm for representing cell complexes computing the aspect ratio of the various shapes and clustering to identify the connected components and comparing with the threshold. |
| [3] | An Improved Parallel Thinning Algorithm | this algorithm uses the various elimination rules formed by the combination of neighbors in a 3*3 window for elimination and connectivity is maintained by not eliminating the pixels in the horizontal and vertical section. |
| [4] | An Efficient Algorithm of Thinning Scanned Pencil Drawings | proposed a thinning algorithm using for scanned pencil drawings essential for the vectorization process in computer aided 2D cartoon producing system by designing a line following algorithm which performs one pass of image scan to detect the starting points and two passes of contour tracing |
| **Ref No** | **Name of Paper** | **Method** |
| [5] | Contour Line Extraction from Paper-based Topographic Maps | In this approach, firstly segment color topographic maps for achieving the binary image of brown color contour lines. Then, mathematic morphology method is used to filter the binary image. Next, Utilizing c-means algorithm to look for initial seed point on thinning contour lines. Fourthly, utilizing improved active contour model to extract non thinning contour lines. Last, analyze the directional field of contour lines near the gap, and then reconnected broken contour lines |

TABLE 1. RELATED WORK

 

## III. PROPOSED THINNING ALGORITHM

Algorithm based on binary image thinning assume that images that are to be processed and thinned have only two intensity values 0 and 1, thresholding technique is used in the input image having more than two intensity values to be converted to binary image as a preprocessing step. The various parts of the image are represented with zeros and ones in matrix representation which define the shape of the image. The matrix is scanned in all possible locations traversing all pixels. The structural information of the image is justified with the pixel set to one(foreground),and the pixel set to zero( background) that do not have any relevance to the feature of interest.

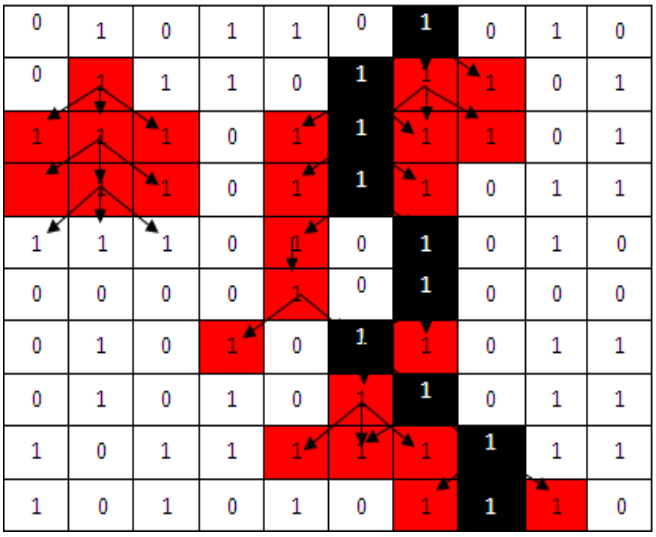

Figure1: Thinning process

*Step 1: Determine the segments in the reference image that represent the image to be thinned*

i) Scan the reference image from left to right and top to bottom for detecting the pixels of interest that is represented by the significant value 1.

ii) If a value 1 is detected in the left traversal continue in the window frame n*n till the end pixels in the row is encountered.

iii) Save the coordinates where the values of the pixel ==1 so that the status of the pixels is maintained.

*Step 2. Scan for immediate neighbors.*

i) Check for immediate neighbors of the saved coordinates both vertically and diagonally.

ii) From the saved coordinates do not consider the coordinates without the immediate neighbors.

iii) Save the coordinates of the neighbors encountered.

iv) Scan the reference image left to right and top to bottom repeating the step 1 and step 2 till the end coordinate of the image.

*Step 3. Thinning the image.*

i) Choose the coordinates of the pixels which have the maximum no. of neighbors through the traversal for all preceding nodes.

ii) Trace the path through the image considering the maximum no. of neighbors to obtain the optimal line that skeletons the image

.

## IV. RESULTS BASED ON PROPOSED THINNING ALGORITHM

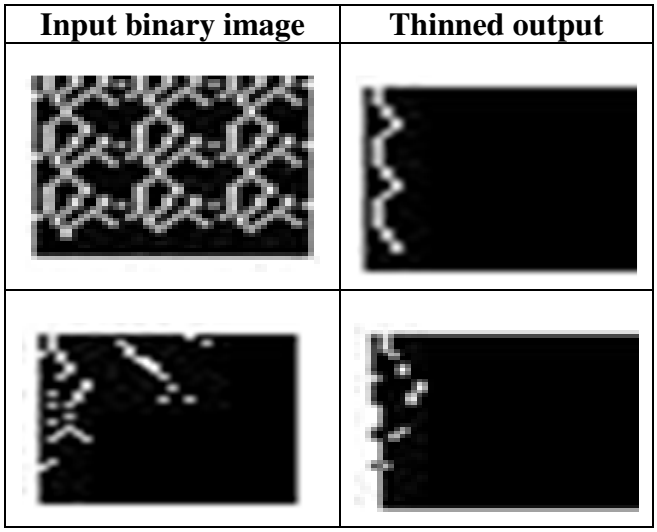


Figure 2: Output of Thinning

The proposed thinning algorithm is successfully implemented to thin linear morphological features and thereby maintaining the connectedness of the features by considering the maximum number of pixel neighbors through the traversal. This algorithm can be further modified to be implemented for non linear features

## ACKNOWLEDGMENT *(HEADING 5)*

I am highly indebted to Mr. Mohan Pradhan my project guide for his guidance and assistance through this work, without his support and guidance this work wouldn't have been possible.

I would also like to thank (Director, Sikkim Manipal Institute of Technology) for giving me an opportunity to be associated with this project.

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## AUTHORS PROFILE

Mrs. Kapila Sharma is Assistant professor in Sikkim Manipal

Institute of Technology,Majitar,Sikkim. She had received bacholars degree form North Bengal University in Computer Science , Degree of Masters of Computer Application form bangalore university, Masters of Techology form SMIT majitar. Her area of interest is Remote Sensing and Geographic Information System.

 