Optimization of Image Using Skeletonization Technique with Advanced Algorithm

1Sarita Jain, 2Sumit Rana
1, 2Department of CSE, Geeta Engineering College, Panipat, India

ABSTRACT
A number of image processing and pattern recognition application demand that raw digitized binary pattern array be normalized, so that the constituents components of that array are of uniform thickness. The skeletonization process reduces such components to a thickness of one pixel or sometimes to a few pixels. The skeletonization of binary images has been studied extensively since the early sixties. During these years, many skeletonization algorithms for data compression by skeletonization have been devised and applied to a great variety of patterns for different purpose. For example, in the biomedical field, this technique was found to be useful in the early 1960’s, when a “shrink” algorithm was applied to count and size the constituent parts of white blood cells in order to identify abnormal cells. Since that time, applications in this area have included analysis of white blood cells and chromosomes, automatic X-ray image analysis and pattern recognition. This wide range of application shows the usefulness of reducing the patterns to thin line representations, which can be attributed to the need to process a reduced amount of data as well as to the fact that shape analysis can be more easily made on line like patterns. In this paper we are making advanced parallel skeletonization algorithm for reducing width of pixels.

KEYWORDS: Database, C language.

I. INTRODUCTION
Skeletonization is a morphological operation that is used to remove selected foreground pixels from binary images[4]. It can be used for several applications, but normally only applied to binary images, and produces another binary image as output. The skeletonization operation is related to the hit-and-miss transform, and so it is helpful to have an understanding of that operator before reading on. The term ‘skeleton’ has been used in general to denote a representation of a pattern by a collection of thin arcs and curves. Other nomenclatures have been used in different context. For example the term ‘medial axis’ is being used to denote the locus of centers of maximal blocks. Some authors also refer to a ‘thinned image’ as a line drawing representation of pattern [5]. In recent years, it appears that the term ‘skeleton’ is used to refer to the result, regardless the shape of the original pattern or the method employed [6]. Thus, skeletonization is defined as process of reducing the width of pattern to just a single pixel. This concept is shown in Fig1.0

![Fig. 1.0: A set of objects with skeletons superimposed.](image)

II. WORKING OF SKELETONIZATION
Like other morphological operators, the behavior of the skeletonization operation is determined by a structuring element. The binary structuring elements used for skeletonization are of the extended type described under the hit-and-miss transform (i.e. they can contain both ones and zeros). The skeletonization operation is related to the hit-and-miss transform and can be expressed quite simply in terms of it. The skeletonization of an image I by a structuring element J is:

\[
\text{thin}(I, J) = I - \text{hit-and-miss}(I, J)
\]

In everyday terms, the skeletonization operation is calculated by translating the origin of the structuring element to each possible pixel position in the image, and at each such position comparing it with the underlying image structuring element exactly match foreground and background pixels in the image, then the image pixel underneath the origin of the structuring element is set to background (zero). Otherwise it is left unchanged. Note that the structuring element must always have a one or a blank at its origin. The choice of structuring element determines under what situations a foreground pixel will be set to background, and hence it determines the application for the skeletonization operation. For example, consider the structuring elements as shown in Fig. 1.1
At each iteration, the image is first skeletonized by the left hand structuring element, and then by the right hand one, and then with the remaining six 90° rotations of the two elements. The process is repeated in cyclic fashion until none of the skeleton produces any further change. As usual, the origin of the structuring element is at the center. Fig. 1.2 shows the result of this skeletonization operation on a simple binary image.

We have described the effects of a single pass of a skeletonization operation over the image. In fact, the operator is normally applied repeatedly until it causes no further changes to the image (i.e., until convergence). Alternatively, in some applications, e.g., pruning, the operations may only be applied for a limited number of iterations.

A. Requirements
The skeletonization process has following requirements
1. Geometrical: The skeleton must be in the middle of the original object and must be invariant to translation, rotation, and scale change.
2. Topological: The skeleton must retain the topology of the original object.

III. PROBLEM FORMULATION
The reduction of image can eliminate some counter distortions while maintaining significant topological and geometric properties. In more practical terms, thin-line representations of elongated patterns would be more suitable for extraction of critical features such as end-points, junction-points, and connection among the components. The vectorization algorithms often used in pattern recognition tasks also require one-pixel-wide lines as input.

Therefore, in real world, we have to thin the various images like BMP images to minimize the data to be handled, therefore there is need to have a software which can thin the images. There is need to study the various aspects of skeletonization concepts. Keeping in mind that our goal is to come up with a set of strokes representing our original image, it would be nice to have a way to preserve the orientation of our shapes while removing information that doesn't interest us. One possibility is to consider the skeleton of an object.

We approximate the skeleton with a skeletonization filter which gradually removes pixels from the borders of objects until something that looks a lot like the skeleton remains [7]. This skeletonization algorithm has two desirable features; the first is that it will not remove any pixel that would cause one object to become two disconnected objects. It is also sensitive enough to properly thin segments which are two pixels thick.

Any good skeletonization algorithm must favor one direction over another in order to avoid removing every pixel in search of the one-true-single-pixel skeleton. The problem of connectivity has been solved in this algorithm which was present in the previous algorithms. Optical character recognition (OCR) is the process of converting scanned images of machine printed or handwritten text into a computer processable format. Handwritten symbol recognition has received and continues to receive much attention by many researchers.

IV. PAST WORK
T. Y. ZHANG et. al [1] in their research paper “A fast parallel algorithm for thinning digital patterns” presented a parallel algorithm for skeletonizing different types of digital patterns. The algorithm is divided into two sub iterations that remove the boundary and corner points of the digital patterns. The first sub iteration aims at deleting the south-east boundary points and the north – west corner points, the second sub iteration is aimed at deleting the north-west boundary points and the south-east corner points. After several iterations only a skeleton of the pattern remains.

Ben K. Jang et al.[2] in their paper “One pass parallel thinning : analysis, properties and quantitative evaluation” defined skeletonization as a procedure to transform a digital pattern, say, a connected component , to a connected skeleton of unit width. The one-pass parallel algorithm proposed requires only a single pass per iteration and uses a set of 5x5
templates. However, because of the limitation of the square-grid representation, resulting skeleton do not always closely approximate their corresponding medial axes. A number of other important issues, such as medial axis presentation, noise sensitivity, and over shrinking have been addressed. A set of measures to evaluate the proposed skeletonization algorithm are also discussed. The skeletonization algorithm is further extended to the derived grid for an isotropic medial axis representation.

M.V.Nagendraprasad et al. [3] in their paper “An improved algorithm for thinning binary digital patterns” presented a parallel algorithm which yield good results with respect to speed and connectivity. However during implementation, the algorithm involves a number of time consuming steps.

V. PROPOSED WORK
We propose the following plan for carrying out the present work:

1. To create a database of regional language numerals from different users.
   We create a database of hand written regional language numerals by considering the data created by different persons so that results can be observed for large image database.

2. To visualize the outputs of the two parallel skeletonization algorithms.
   We implement the two parallel skeletonization algorithms for BMP images using C language. The outputs of these two algorithms are visualized to examine the connectivity of pixels and generation of spurious branches.

3. To give an alternative parallel skeletonization algorithm
   We discuss an alternative parallel skeletonization algorithm and then implement the same using C language.

4. To compare the performance features of alternative parallel skeletonization algorithm.
   We visualize the results of the alternative skeletonization algorithm and compare with the results of the previous two algorithms.

B. Research Objective
Following are the primary objectives of the research.

- To reduce the amount of data required to be processed.
- To reduce the time required to be processed.
- Extraction of critical features such as endpoints, junction-points, and connection among the components.
- The vectorization algorithms often used in pattern recognition tasks also require one-pixel-wide lines as input.
- Shape analysis can be more easily made on line like patterns.

C. Objectives
We aim to achieve the following objectives:
- To give an alternative parallel skeletonization algorithm.
- To visualize and compare the performance of given alternative algorithm in terms of connectivity for regional language numerals.

VI. Conclusion
The different parallel skeletonization algorithms give different results in terms of maintaining the connectivity and generating the spurious branches. When we implement the discussed alternative parallel skeletonization algorithm we observe that it provides better connectivity of pixels in the thinned image for almost all the test images.

In the proposed algorithm we apply the single template in each pass and the output of each pass is passed onto the next pass, the connectivity and one-pixel width is guaranteed.

REFERENCE