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Regulating Image by Exciuding Plethora Skleton from Morphological Skeleton Transform

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ABSTRACT:- This paper presents the results of a study on the use of morphological set operations to represent and encode a discrete binary image by parts of its skeleton, a thinned version of the image containing complete information about its shape and size. Morphological processing is constructed with operations on sets of pixels. Binary morphology uses only set membership and is indifferent to the value, such as gray level or color, of a pixel. We will examine some basic set operations and their usefulness in image processing. The concepts of a globally and locally minimal skeleton are introduced and fast algorithms are developed for obtaining minimal skeletons. The focus is on methods that lie close to the field of computational geometry. Morphological transformation of an image object is said to be quantitative only if it satisfies four quantification constraints, which correspond to the four basic principles of the theory of mathematical morphology:

1) invariance under translation,
2) compatibility with change of scale,
3) local knowledge,
4) Upper semi continuity

The highest level of image compression was obtained by using Elias coding of the skeleton.

I. INTRODUCTION

It is well known that there are many different learning styles. Some people learn better by reading books, others through a verbal explanation, while others learn most effectively through application. The goal of this project is to add another tool to the learning style, one focused on a visual learning style. By developing an application to demonstrate some tools of morphological image processing, the goal is to add another tool to the learning processes. We will deal here only with morphological operations for binary images. This will provide a basic understanding of the techniques. Morphological processing for gray scale images requires more sophisticated mathematical development. Morphological processing is described almost entirely as operations on sets. In this discussion, a set is a collection of pixels in the context of an image. Our sets will be collections of points on an image grid G of size N × M pixels.

II. BACKGROUND

Morphological image processing relies on the ordering of pixels in an image and many times is applied to binary and grayscale images. Through processes such as erosion, dilation, opening and closing, binary images can be modified to the user's specifications.

2.1 Dilation/Erosion:-

First, define A as the reference image and B is the structure image used to process A.
Dilation is defined by the equation:
$A\ B\ \{z \mid [(\hat{B})\ A]\ A\}\ z$ ……
Where $\hat{B}$ is B rotated about the origin. Dilation has many uses but a major one is
bridging gaps in an image due to the fact that B is expanding the features of A.
Dilation on the other hand can be considered a narrowing of features on an image. Again
defining A as the reference image and B as the structure image:
$A\ B\ \{z \mid (B)\ A\}\ z$ …..
Many times dilation can be used for removing irrelevant data from an image.

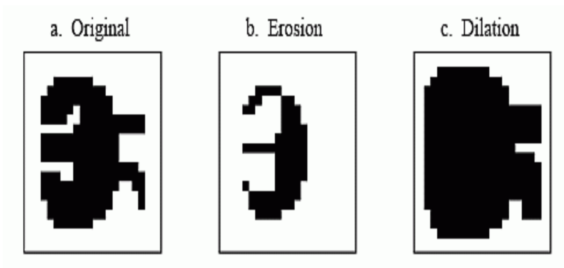
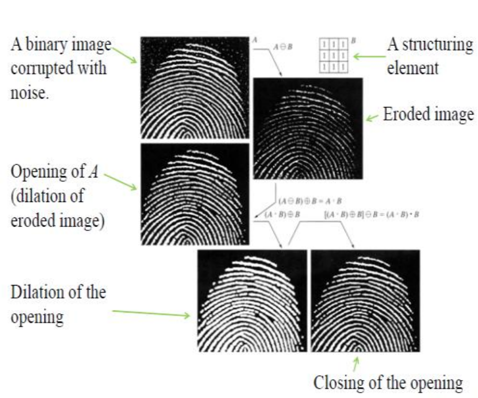


Fig 1. Erosion (b) and dilation(c) of image (a) Source: [2]

2.2 Opening/Closing:-



By utilizing the processes of erosion and dilation, opening and closing is simply and extension of these applications. The process of "opening" an image will likely smooth the edges, break narrow block connectors and remove small protrusions from a reference image. "Closing" an image will also smooth edges but will fuse narrow blocks and fill in holes. Opening:
$A.\ B\ .\ (A.B).\ B$
Closing:

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$A. B . (A. B).B$

By these definitions, the opening of A is the erosion of A by B and then that image
dilated by B. The closing of A is the dilation of A by B and

then eroded by B.

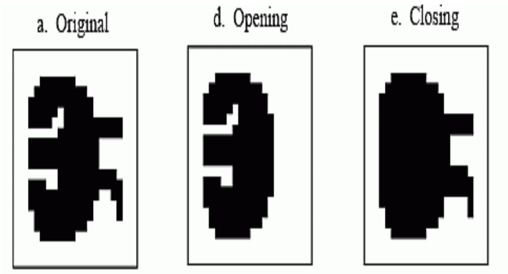


Fig 2. Opening (d) and Closing (e) of image (a) Source: [2]

By knowing that dilation and erosion are duals of each other:

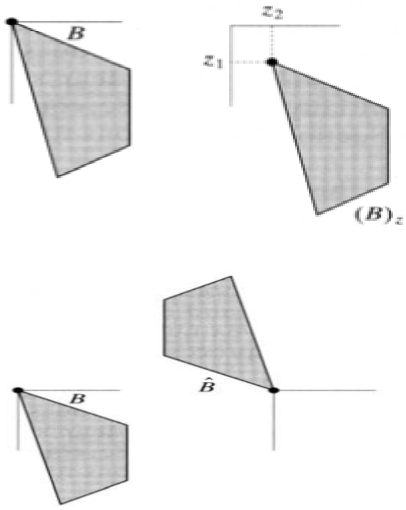
$(A.B)c . Ac . B\hat{}$

we can conclude that with respect to set complementation and reflection, that opening
and closing are complements of each other:

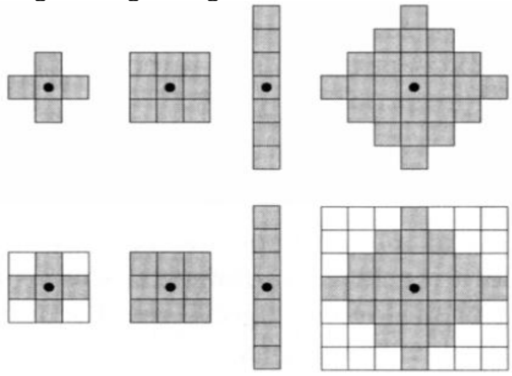
$(A B)c Ac B\hat{}$.

III. PRELIMINARIES

3.1 If B is a set of pixels (2D points) representing an object in an image, then its reflection is the set of points in B, whose (x, y) coordinates have been replaced by $(-x, -y)$ as shown: The ***translation*** of a set B by point $z = (z1, z2)$, denoted $(B)z$ is defined as $B = c\ c = b + z$ *for* $b \in B$ If B is the set of pixels, $(B)z$ is the set of points, whose coordinates (x, y) were replaced by $(x+z1, y+z2)$.

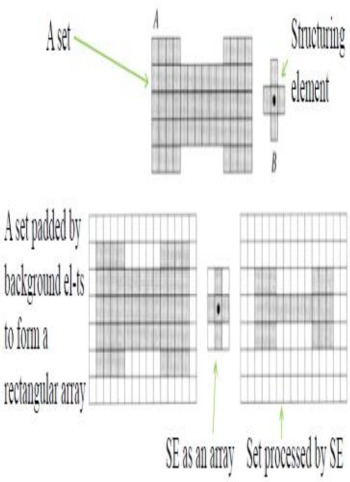


3.2 Reflection And Transmission Are Used Extensively To Formulate Operations Based On So-Called Structuring Elements (Ses): Small Sets Of Sub Images Used To Probe An Analyzed Image For Properties Of Interest. Examples Of Structuring Elements: Shaded Square Denotes A Member Of The SE



The origins of SEs are marked by a black dot.
When working with images, SEs should be rectangular: append the smallest number
of background elements.

3.3



The operation: create a new set by running B over A such that the origin of B visits every element of A; at each location of the origin of
B, if B is completely contained in A, mark that location as a member of a new set. As a result, the boundary of A is *eroded*.

IV. DILATION

4.1 With A and B as sets in $Z2$, the ***dilation*** of A by B is defined as

$A \oplus B = \{z \mid (B\hat{}z) \cap A \neq \emptyset\}$

This equation is based on reflecting B about its origin, and shifting this reflection by z. The dilation of A by B then is the set of all displacements z, such that and A overlap by at least one element. Therefore, the dilation can also be expressed as

$A \oplus B = z \left[\left[B \cap A \right]\right] \subseteq A$

As before, we assume that B is a structuring element and A is the set (image object) to be dilated.

4.2 There are other definitions of dilation too. However, the preceding equations are more intuitive when viewing the structural element as a convolution mask. We need to keep in mind that dilation is based on set operations and

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therefore is a nonlinear operation, while the convolution is linear. Unlike the erosion, dilation "grows" or "thickens" objects in a binary image The manner and extend of this growth is image. controlled by the structuring element.

V. APPLICATION

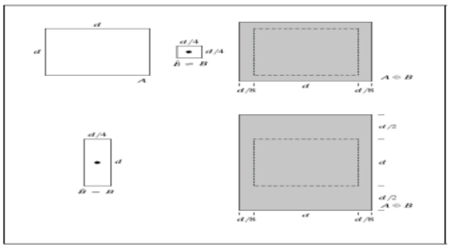
The application developed allows the user to perform four main operations to an image: dilation, erosion, opening and closing. Listed below are a few of the functionalities of the program:

Visual inspection of image processing allows the user to see how the structure image affects the original image.
Variable playback speeds allows the user to control the speed at which the structure
image is processed through the image so a user can see how it affects the final image.
User defined structure image lets the user control what the 3x3 structure image looks
like and allows users the ability to see how different structure images affect different
images.
User defined images lets the user define an image up to 16x16. By clicking on the
different cells, a user can setup up an image to their specifications before processing.
Rewind functionality enables a user to revert back to the original image if multiple
passes were made during image processing (such as during

opening and closing)

VI. MORPHOLOGICAL DILATION

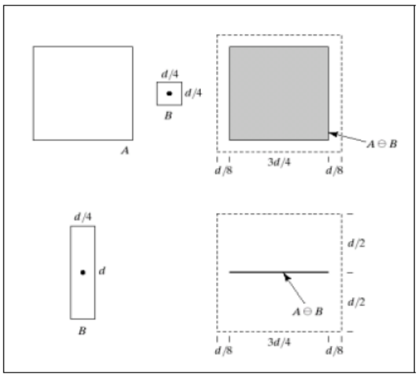
Any pixel in the output image touched by the in the structuring element is set to ON when any point of the structuring element touches a ON pixel in the original image.



This tends to close up holes in an image by expanding the ON regions. It also makes objects larger. Note that the result depends upon both the shape of the structuring element and the location of its origin.

VII. MORPHOLOGICAL EROSION

Any pixel in the output image touched by the in the structuring element is set to ON when every point of the structuring element touches an ON pixel in the original image.



This tends to makes objects smaller by removing pixels. A . B = {s|(B)s _ A}

VIII. KNOWN BUGS

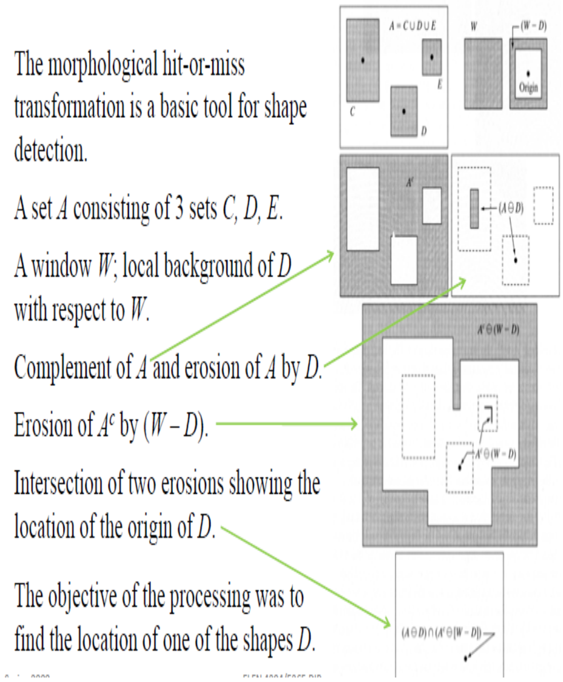
8.1 Major Bugs:-

(1) Due to the fact that this program is single threaded and relies on a timer ticker to control the playback of the moving structure matrix, it is impossible to visually process the first pass during opening and closing. VB.Net does not have a built in pause until even function so the only way to accomplish this would be to multithread the application or place a semaphore around blocks of code. Due to an inexperience in multithreaded applications, there wasn't enough time to accomplish this.

8.2 Minor Bugs:-

(1) If the 'Play' button is pressed while the image is being processed, the final image clears from the point that it has already been processed.
(2) Top corner 2x2 matrix sometimes disappears on the reference image until 'Rewind' or 'Fast Forward' is pushed.

IX. HIT-OR-MIS TRANSFORMATION



We enclose D by a small window W; the ***local background*** of D with respect to W is defined as the set difference $W - D$. The erosion of A by D is the set of locations of the origin of D, such that D is completely contained in A. The intersection of the erosion of the complement of A by the local background set W-D and the erosion of A by D is the set of locations for which D exactly fits inside A. Denoting by B the set consisting of D and its background, the match (or matches) of B in A is

$$A.B = (A.D) \cap \left[A^c .(W - D) \right]$$

X. FUTURE WORK

Due to the fact that this is a teaching tool, it was the goal for this project to make it easy to add to. Here are the items that could be added for the future quite easily:

(1) Image upload and binarization using segmentation, then allowing morphological image processing on the uploaded image

(2) Boundary extraction by subtracting the original image from the eroded image

(3) Hit or miss transformation could be implemented easily with the already included erosion processing

(4) With hit or miss, thinning and thickening could easily be added to the application.

XI. CONCLUSIONS

The main advantage of the generalized skeleton transform is that it leads easily to the construction of a new shape decomposition scheme. The morphological skeleton is a translation-invariant, idempotent set transformation which admits an inverse. The concepts of a globally and locally minimal skeleton were introduced and investigated. By developing appropriate fast algorithms, we found that the minimal skeleton may have more than 50 percent fewer points than the original skeleton and still guarantee exact The skeletal points and the corresponding shape elements still have relatively simple mathematical characterizations. They are determined using simple and well-defined erosion steps. The main advantage of the generalized skeleton transform is that it leads easily to the construction of a new shape decomposition scheme reconstruction.

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