

Morphological Operations Applied to Digital Art Restoration

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29 April 2014
UMM CSci Senior Seminar Conference
University of Minnesota, Morris

Why?

Art restoration preserves objects of artistic, cultural, or historical value.

Digital art restoration provides:

- a comparatively inexpensive alternative.
- a nondestructive tool.
- an approximation of the initial appearance.

Outline

- 1 Edge Detection
- 2 Morphological Operations
- 3 Methods of Crack Detection
- 4 Inpainting
- 5 Results
- 6 Conclusions

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Criteria

- 1 Accuracy - low error rate
- 2 Localization - minimal distance between detected and actual edge
- 3 Uniqueness - only one response to a single edge

Canny Algorithm

- 1 Smooth image by applying Gaussian filter.
- 2 Take gradient of image.
- 3 Identify regions containing significant jumps in intensity.
- 4 Search regions for local maximum.
- 5 Compare remaining pixels to two thresholds.

Outline

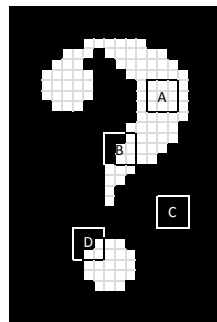
- 1 Edge Detection
- 2 Morphological Operations
 - Erosion
 - Dilation
 - Opening
 - Closing
- 3 Methods of Crack Detection
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Morphological Operations

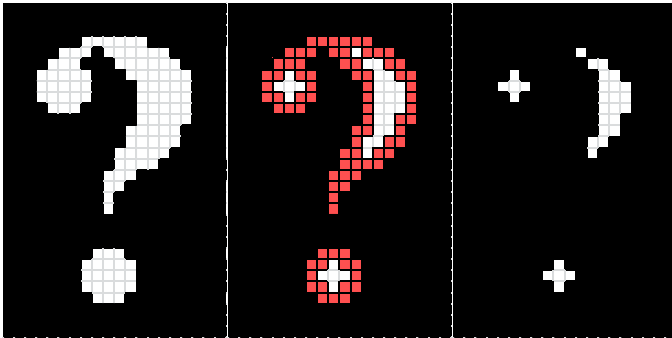
Binary and Greyscale Images

Two Inputs:

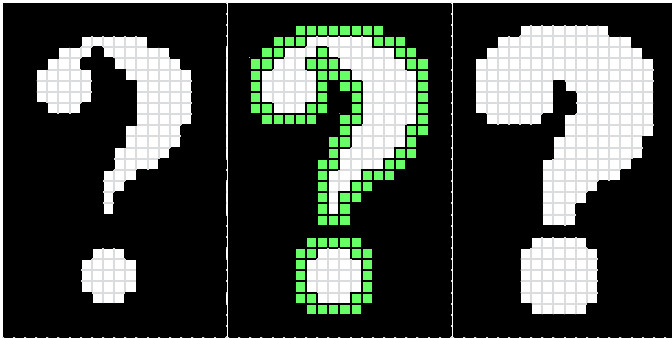
- Original Image
- Structuring Element



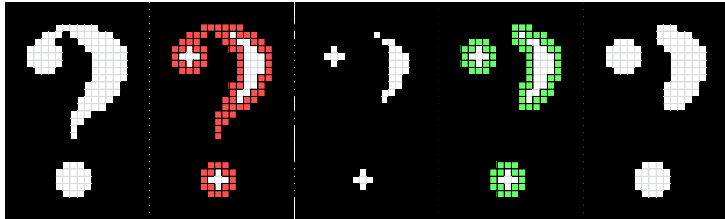
Erosion



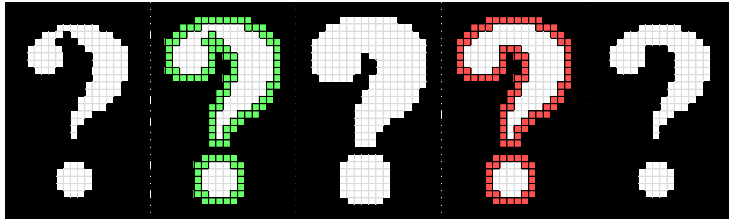
Dilation



Opening



Closing



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- 1 Edge Detection
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Top-Hat Algorithm

Three Variations:

- Black Top-Hat
- White Top-Hat
- Multiscale Top-Hat

Black Top-Hat Transform

Darker Details on a Lighter Background

$$BTH = (f \bullet s) - f$$

White Top-Hat Transform

Lighter Details on a Darker Background

$$WTH = f - (f \circ s)$$

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Inpainting Process

The image is broken down into regions, which are further broken down into neighborhoods. For each defective pixel i :

- 1 Find the context of i .
- 2 Examine all other neighborhoods within the region of i .
- 3 Find neighborhood most similar to context of i by sum of squared differences.
- 4 If the sum of squared errors is below a set threshold, replace all defective pixels in the neighborhood of i with corresponding pixels from most similar neighborhood.
- 5 Otherwise, replace pixel i with the median value of all non-defective pixels within its neighborhood.

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Thanks!

Questions?

References