Escuela Profesional de
Ciencia de la Computación

Computer graphics

Image Arithmetic

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Overview

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Objectives

- Understand about the arithmetic between images.

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Objectives

- Understand about the arithmetic between images.
- Learn addition, subtraction, multiplication, division and blending between images.

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Pixel addition

Definition

This operator takes as input two identically sized images and produces as output a third image of the same size as the first two. Each pixel value is the sum of the values of the corresponding pixel from each of the two input images.

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Pixel addition

Definition

Normal addition :

$$Q(i,j) = P_1(i,j) + P_2(i,j) \tag{1}$$

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Pixel addition

Definition

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Almost always, we need to scale the image:

$$Q(i,j) = P_1(i,j)/2 + P_2(i,j)/2 \tag{2}$$

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Pixel addition

Definition

Normal addition :

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Almost always, we need to scale the image:

$$Q(i,j) = P_1(i,j)/2 + P_2(i,j)/2 \tag{2}$$

Also, we could add a constant value:

$$Q(i,j) = P_1(i,j) + C \tag{3}$$

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Pixel addition

Example with scaling

Figure: Example of pixel addition using Equation 5. OpenCV limits the values to [0-255] (int8).

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Pixel addition

Example without scaling

Figure: Example of pixel addition using Equation 5. We cast the image to int, before the adding operation.

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Pixel addition

Example with scaling

Figure: Example of pixel addition using Equation 2.

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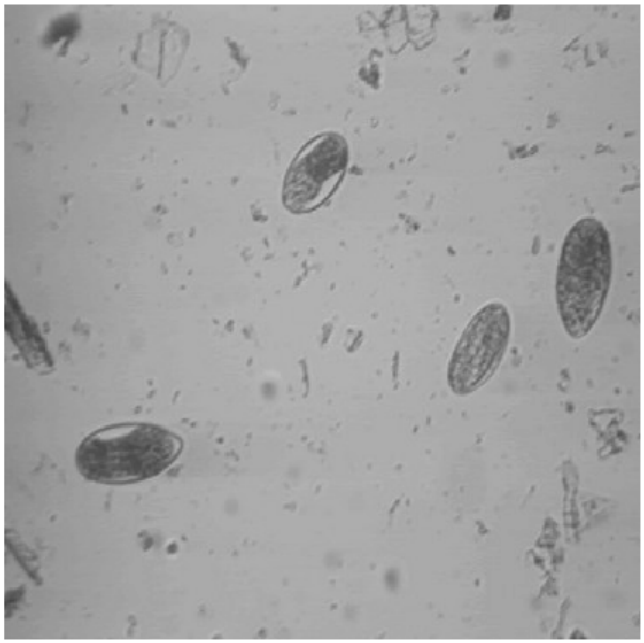
Pixel addition

Image plus constant

Original



Original + 50

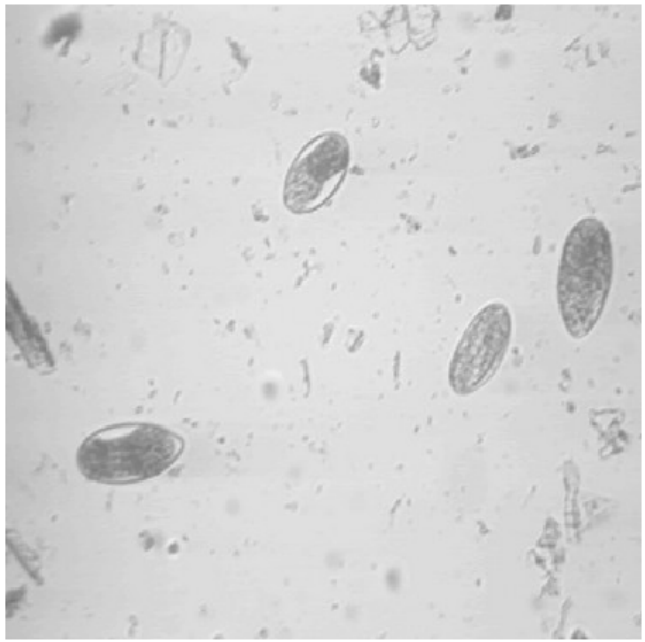


Figure: Adding a constant to a image.

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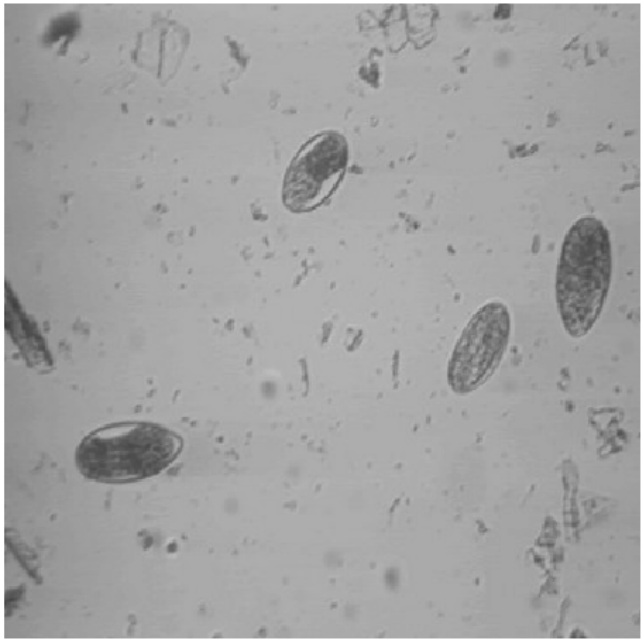
Pixel addition

Image plus constant

Original



Original + 100 (OpenCV)

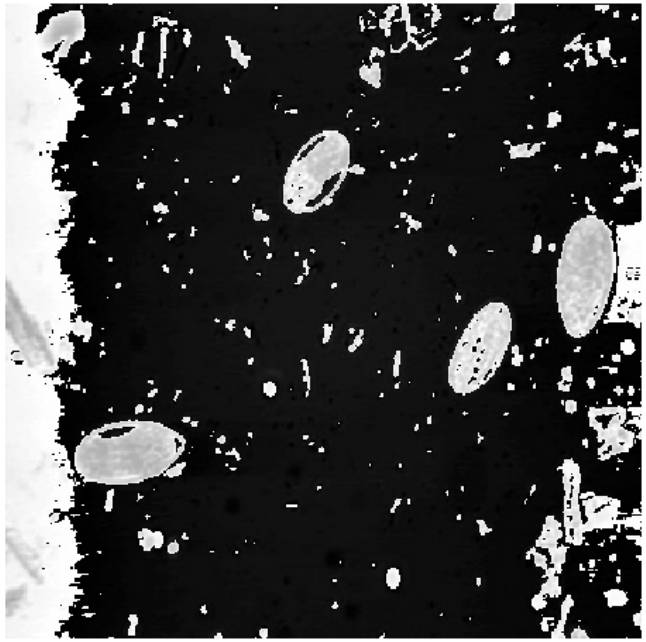


Figure: If you use OpenCV, this problem could occurs. It is because OpenCV limits the pixel values to [0-255].

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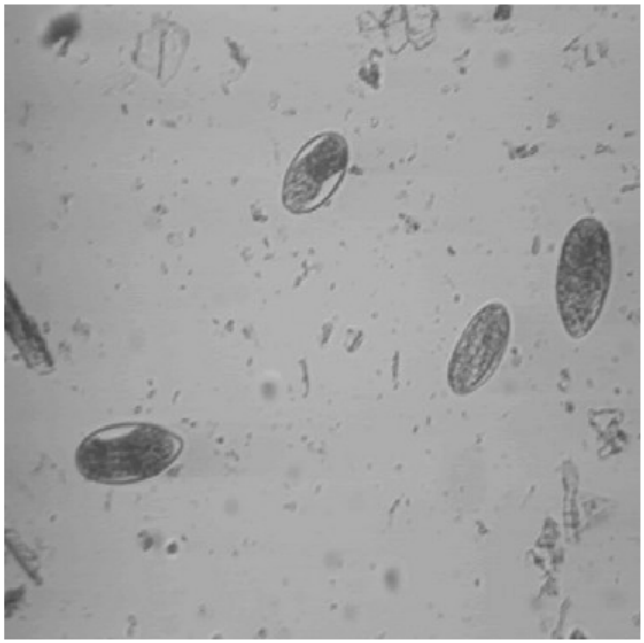
Pixel addition

Image plus constant

Original



Original + 100

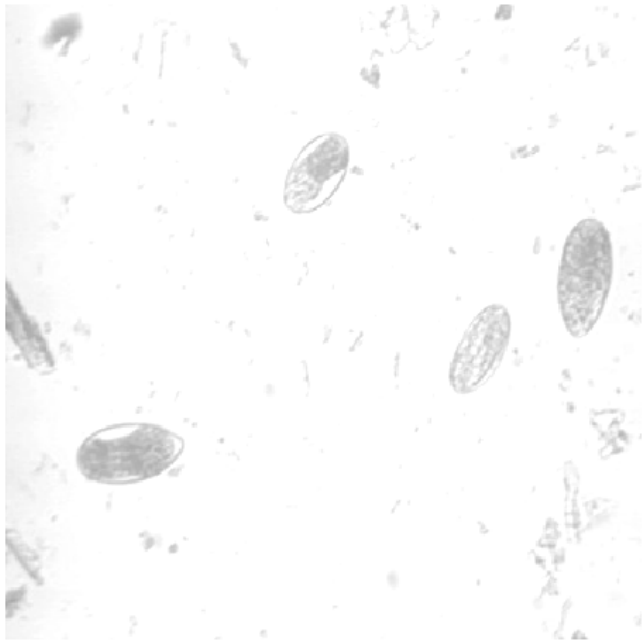


Figure: Before add a constant, cast the image type to int (img = img.astype(int)).

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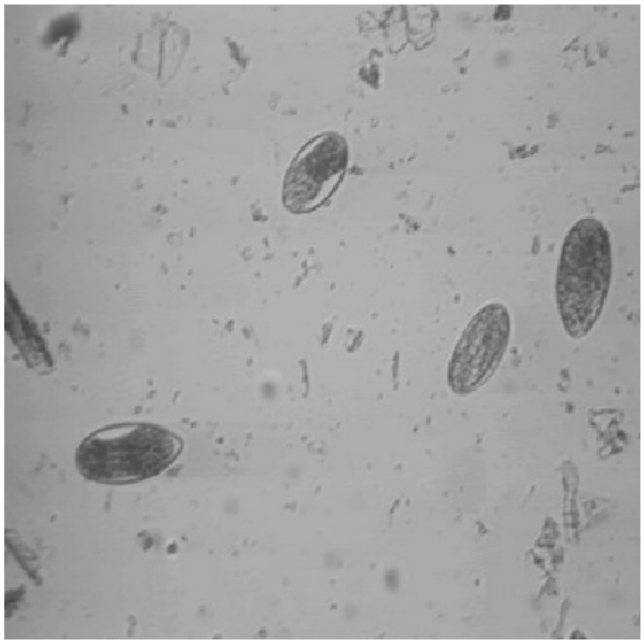
Pixel addition

Image plus constant

Original



Original*0.8 + 100

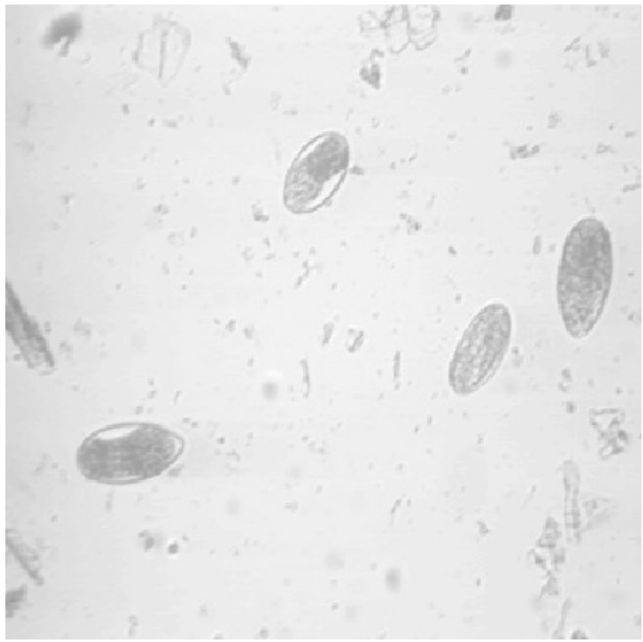


Figure: We scale the image before adding a constant.

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Pixel addition

Image addition with colors

Figure: Two images for addition.

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Pixel addition

Image addition with colors

Figure: Addition of two images with colors.

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Pixel subtraction

Definition

The pixel subtraction operator takes two images as input and produces as output a third image whose pixel values are simply those of the first image minus the corresponding pixel values from the second image.

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Pixel subtraction

Definition

$$Q(i,j) = |P_1(i,j) - P_2(i,j)| \tag{4}$$

$$Q(i,j) = |P_1(i,j) - C| \tag{5}$$

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Pixel subtraction

Example

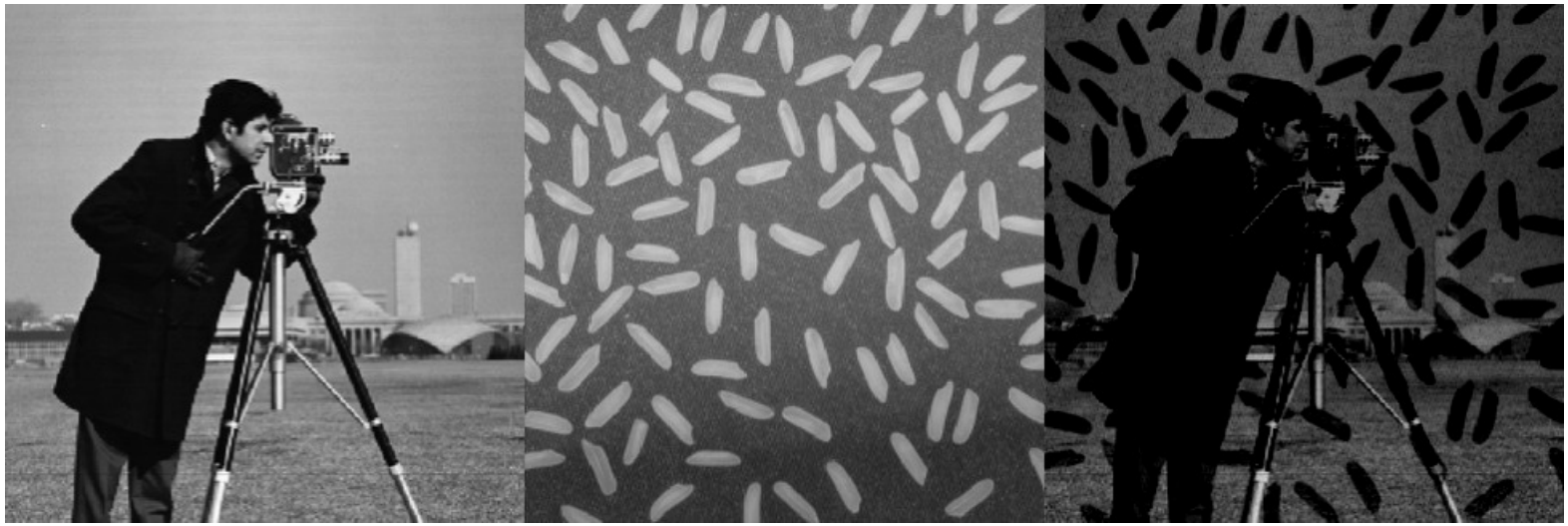

Figure: Example of subtraction operator.

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Pixel subtraction

Applications - Segmentation of Characters

Suppose we want to segment the characters, the result will be:

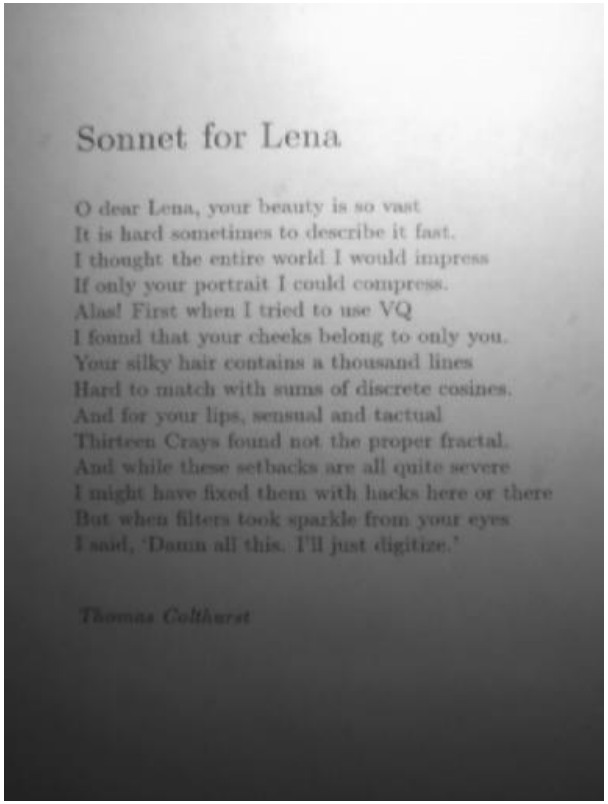

Figure: Photo.

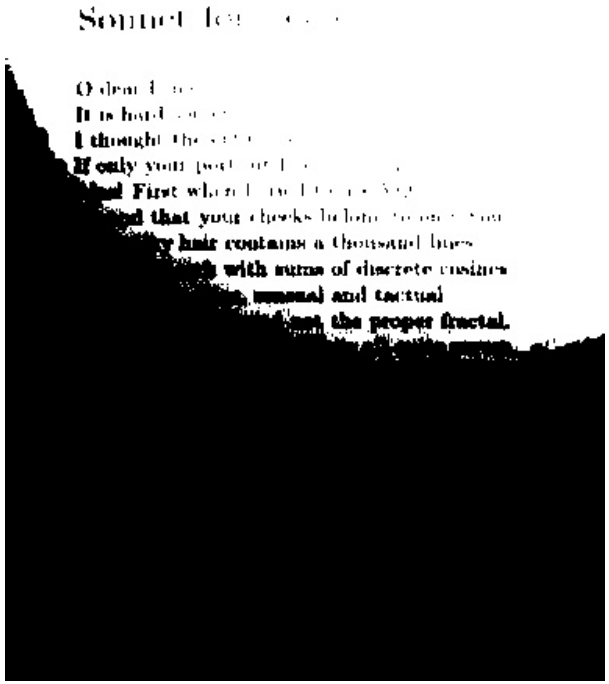

Figure: Thresholding (θ = 127).

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Pixel subtraction

Applications - Segmentation of Characters

We could take a photo of a white paper to apply subtraction:

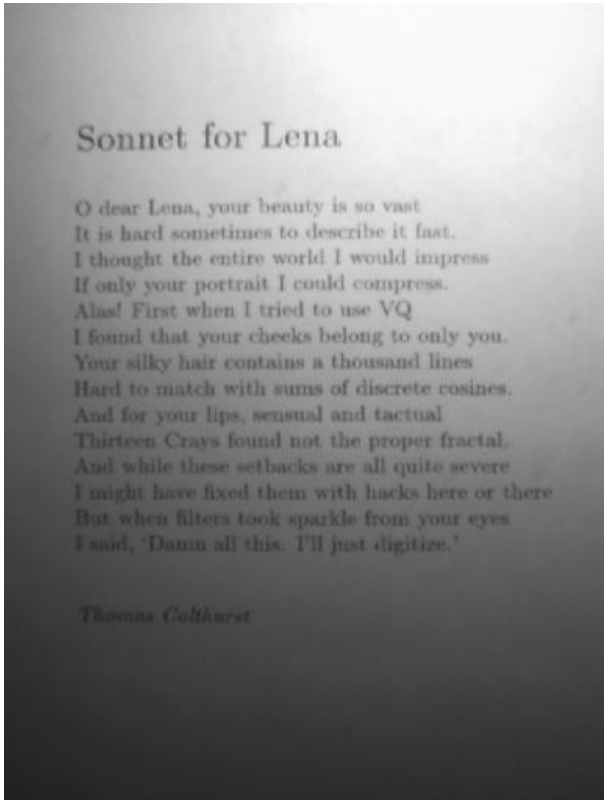

Figure: Photo.

Figure: Photo of white paper.

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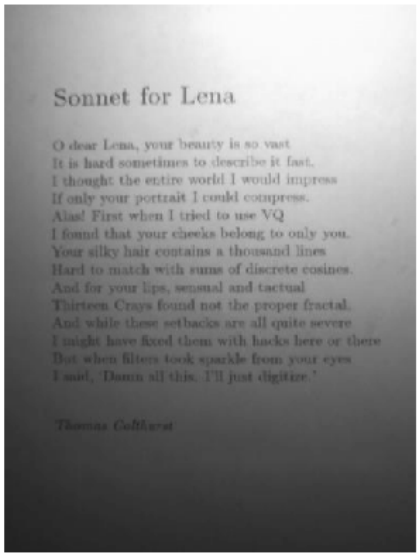
Pixel subtraction

Applications - Segmentation of Characters

We take the normal photo and subtracts the white paper photo to get a new image:

Photo



White paper

Result

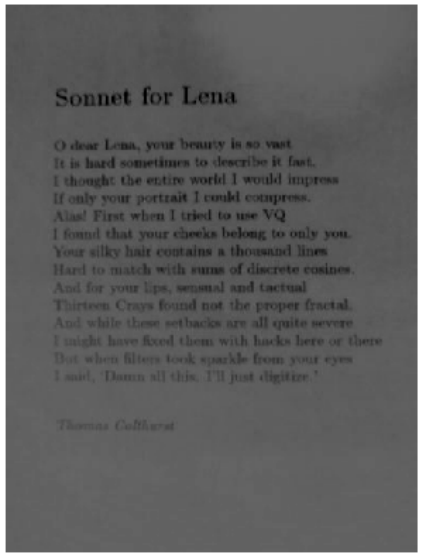


Figure: Result after applying subtraction and an addition of 100 to avoid negative values.

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Pixel subtraction

Applications - Segmentation of Characters

Then we apply thresholding with $\theta = 80$

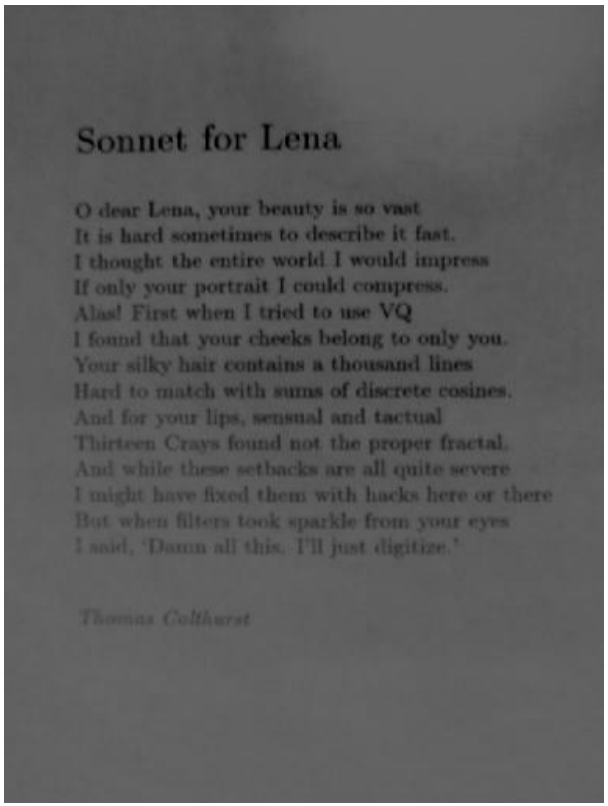

Figure: Difference

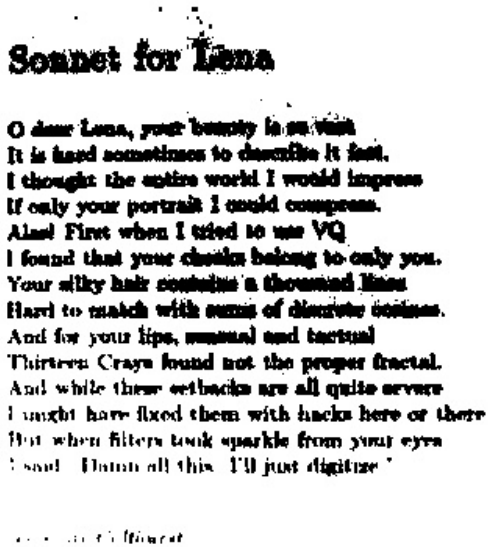

Figure: Thresholding ($\theta = 80$).

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Pixel subtraction

Applications - Segmentation of Characters

Comparison:

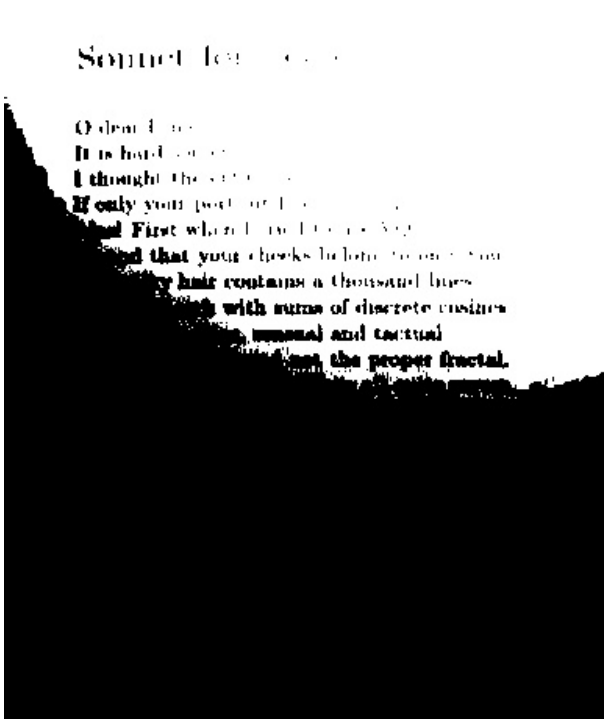

Figure: Without subtraction.

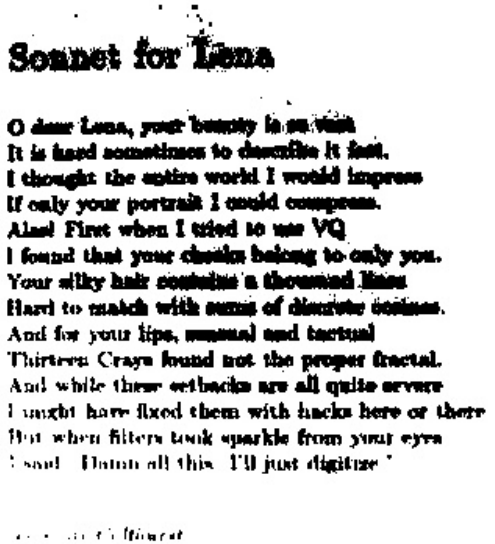

Figure: With subtraction.

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Pixel subtraction

Applications - Change detection

We could use subtraction to detect changes between frames.

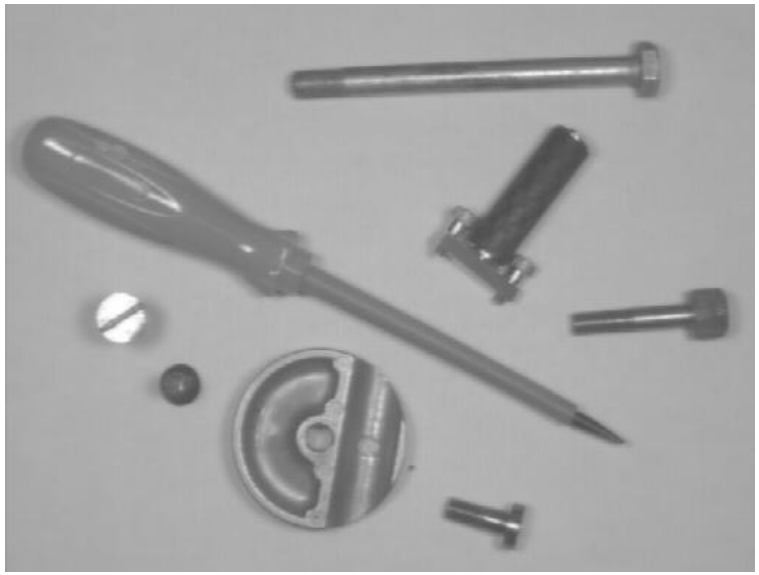

Figure: Frame 1.

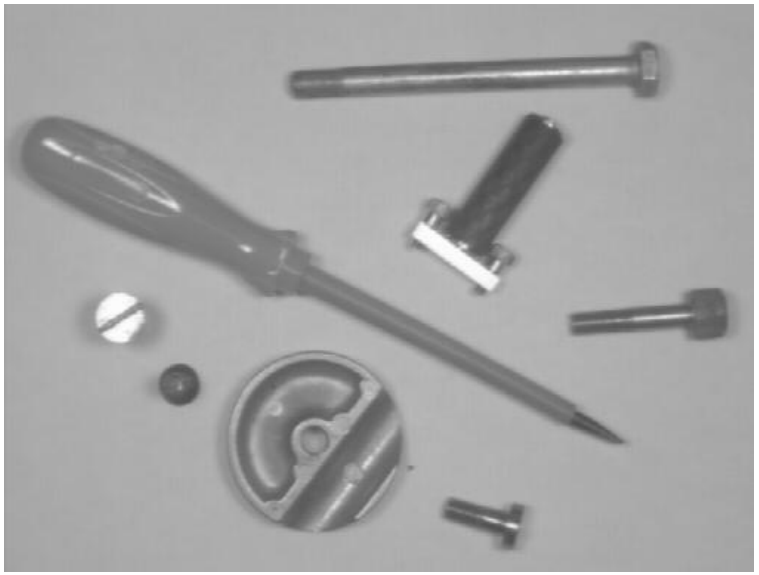

Figure: Frame 2.

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Pixel subtraction

Applications - Change detection

Figure: |Frame 1 - Frame 2| and contrast stretching.

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Questions?

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