Escuela Profesional de
Ciencia de la Computación

Computer graphics

Image Arithmetic

MSc. Vicente Machaca Arceda

Universidad Nacional de San Agustín de Arequipa

May 16, 2020

Overview

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Objectives

- Understand about the arithmetic between images.

vmachacaa@unsa.edu.pe

Objectives

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

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Pixel multiplication

Definition

The first form takes two input images and produces an output image in which the pixel values are just those of the first image, multiplied by the values of the corresponding values in the second image. The second form takes a single input image and produces output in which each pixel value is multiplied by a specified constant.

vmachacaa@unsa.edu.pe

Pixel multiplication

Definition

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

vmachacaa@unsa.edu.pe

Pixel multiplication

Definition

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

$$Q(i,j) = P_1(i,j) * C \tag{2}$$

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Pixel multiplication

Examples

Figure: Original image.

Figure: Original image * 3.

vmachacaa@unsa.edu.pe

Pixel multiplication

Examples

Figure: Original image.

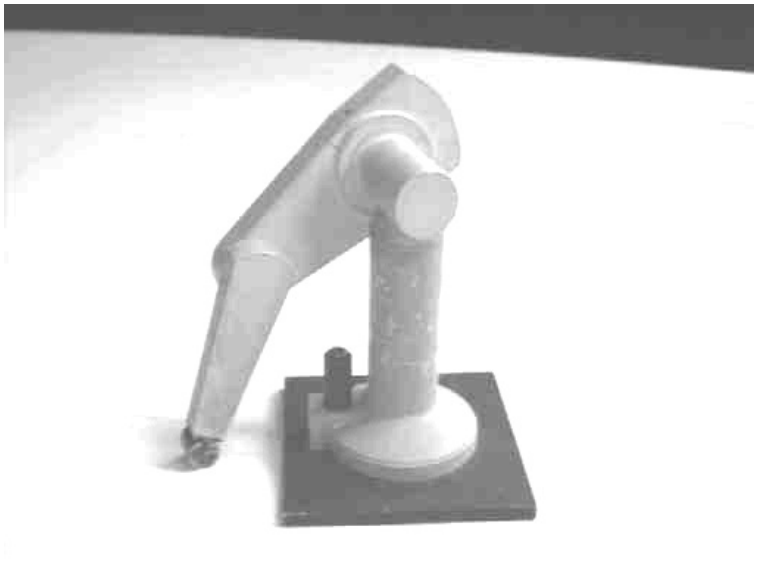

Figure: Original image * 3.

vmachacaa@unsa.edu.pe

Pixel multiplication

Examples

Figure: Original image.

Figure: Original image * 3.

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Pixel division

Definition

The image division operator normally takes two images as input and produces a third whose pixel values are just the pixel values of the first image divided by the corresponding pixel values of the second image.

vmachacaa@unsa.edu.pe

Pixel division

Definition

$$Q(i,j) = P_1(i,j)/P_2(i,j) \tag{3}$$

vmachacaa@unsa.edu.pe

Pixel division

Definition

$$Q(i,j) = P_1(i,j)/P_2(i,j) \tag{3}$$

$$Q(i,j) = P_1(i,j)/C \tag{4}$$

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Pixel division

Change detection

We could use division to detect changes between frames.

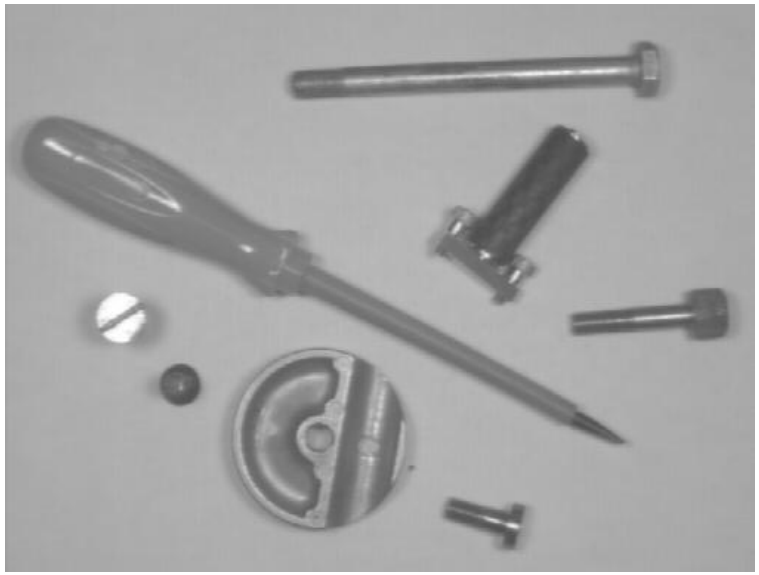

Figure: Frame 1.

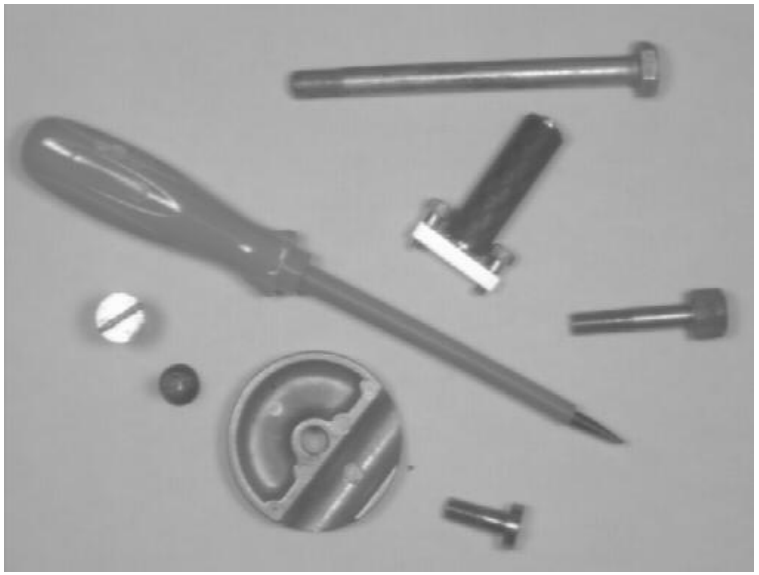

Figure: Frame 2.

vmachacaa@unsa.edu.pe

Pixel division

Change detection

Figure: (Frame 1 / Frame 2)*30.

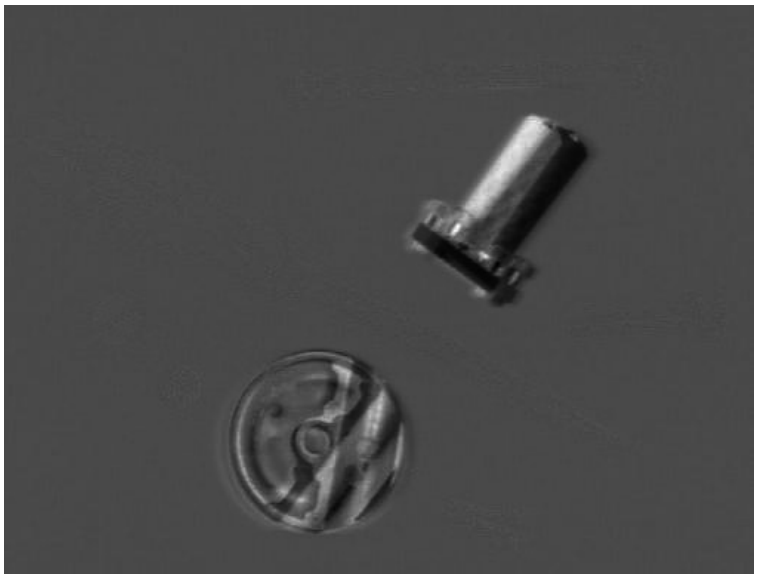

Figure: After contrast stretching.

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Pixel division

Segmentation of Characters

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

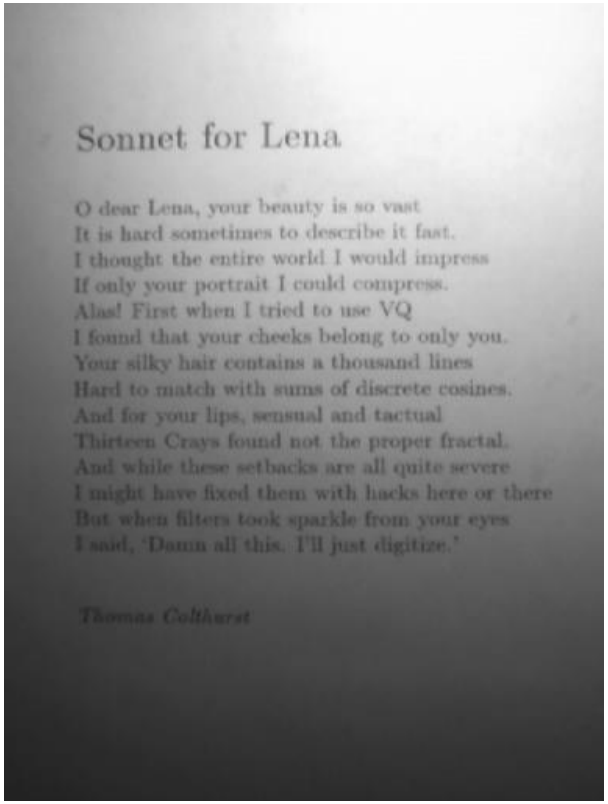

Figure: Photo.

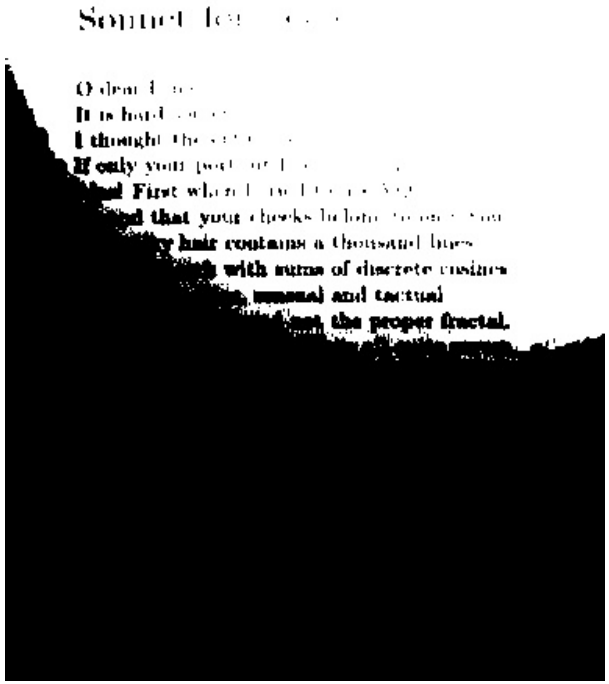

Figure: Thresholding (θ = 127).

vmachacaa@unsa.edu.pe

Pixel division

Segmentation of Characters

$$I' = (I - min)\frac{newMax - newMin}{max - min} + newMin$$

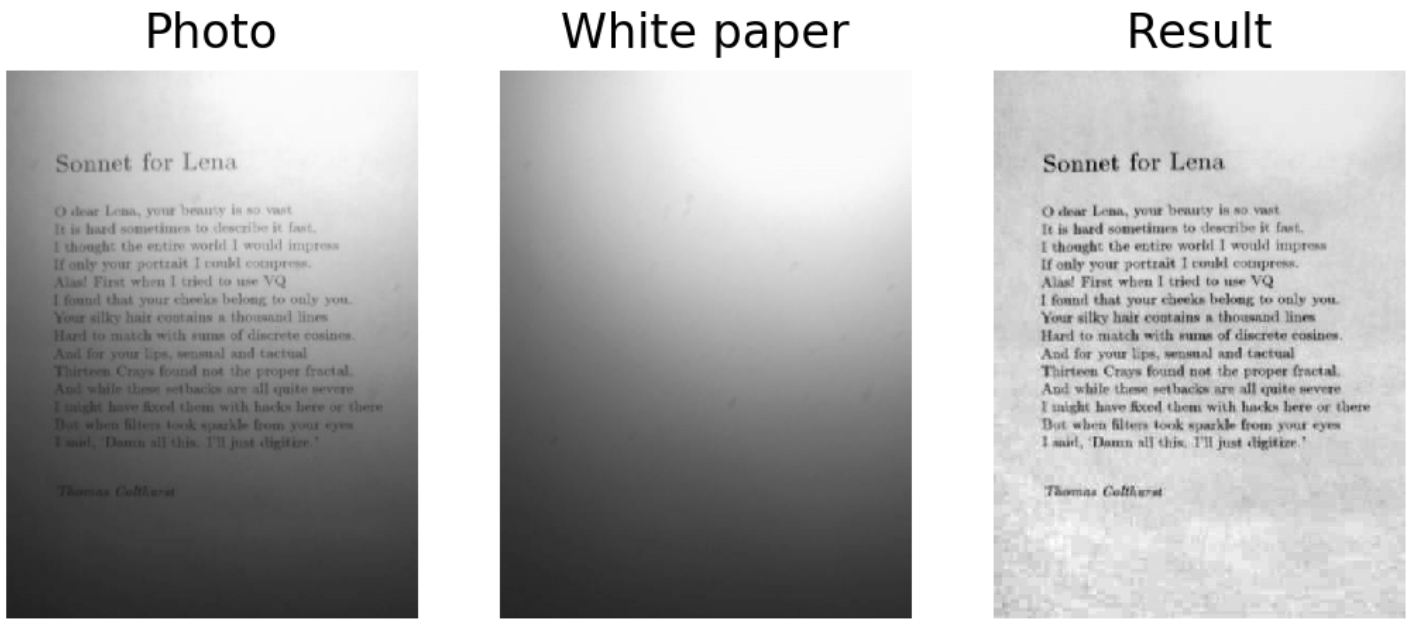

Figure: Division and scaling to [0-255]

vmachacaa@unsa.edu.pe

Pixel division

Segmentation of Characters

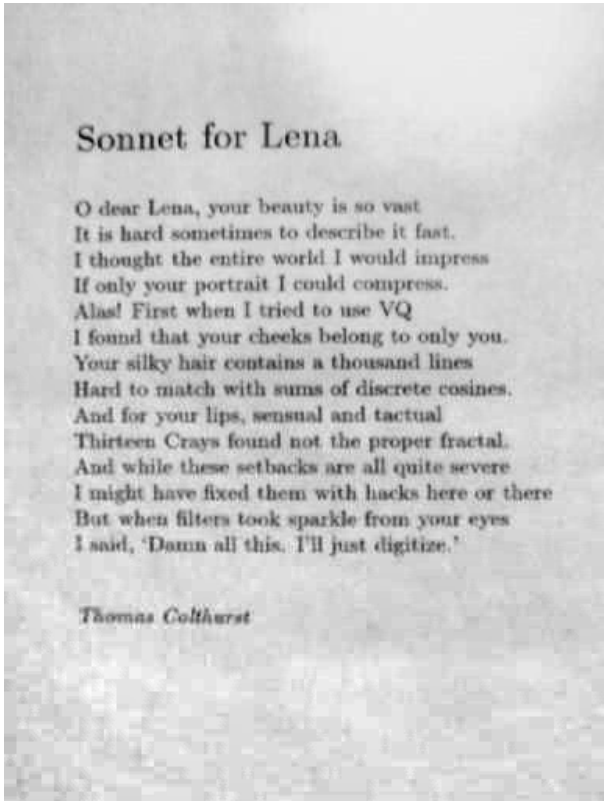

Figure: Division.

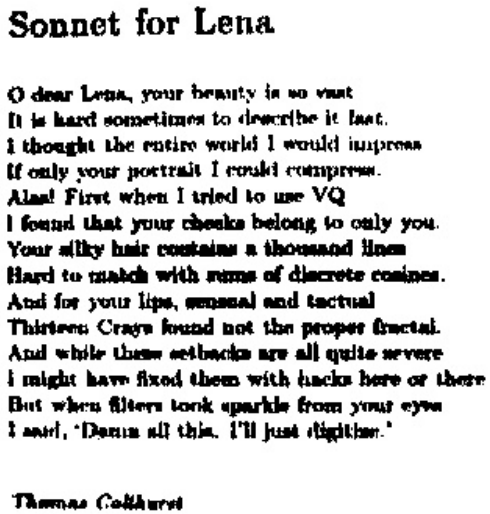

Figure: Thresholding (θ = 170).

vmachacaa@unsa.edu.pe

Table of Contents

vmachacaa@unsa.edu.pe

Blending

Definition

This operator forms a blend of two input images of the same size. Similar to pixel addition, the value of each pixel in the output image is a linear combination of the corresponding pixel values in the input images. The coefficients of the linear combination are user-specified.

$$Q(i,j) = X * P_1(i,j) + (1 - X) * P_2(i,j) \tag{5}$$

vmachacaa@unsa.edu.pe

Blending

Examples

Figure: The images for blending

vmachacaa@unsa.edu.pe

Blending

Examples

Figure: Blending with $X = 0.25$.

vmachacaa@unsa.edu.pe

Blending

Examples

Figure: Blending with $X = 0.5$.

vmachacaa@unsa.edu.pe

Blending

Examples

Figure: Blending with $X = 0.75$.

vmachacaa@unsa.edu.pe

Blending

Examples

Figure: Blending.

vmachacaa@unsa.edu.pe

Questions?

vmachacaa@unsa.edu.pe