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CSCI 55700
Mar. 28 2016

Description

● Canny edge detector

The Canny edge detection algorithm is known to be one of the most optimal edge detector. It first smooth the image to eliminate and noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at the maximum (non-maximum suppression). The gradient array is now further reduced by hysteresis. Hysteresis is used to track along the remaining pixels that have not been suppressed. Hysteresis uses two thresholds and if the magnitude is below the first threshold, it is set to zero (made a non-edge). If the magnitude is above the high threshold, it is made an edge. And if the magnitude is between the 2 thresholds, then it is set to zero unless there is a path from this pixel to a pixel with a gradient above the high threshold.

● Hough transform

The Hough transform is essentially a feature extraction technique used in computer vision and some other areas. The goal is to find imperfect parts of objects within a specific kind of structure by a voting mechanism. This voting mechanism is performed in a parameter space. In this project, only the lines detection of Hough transform is applied.

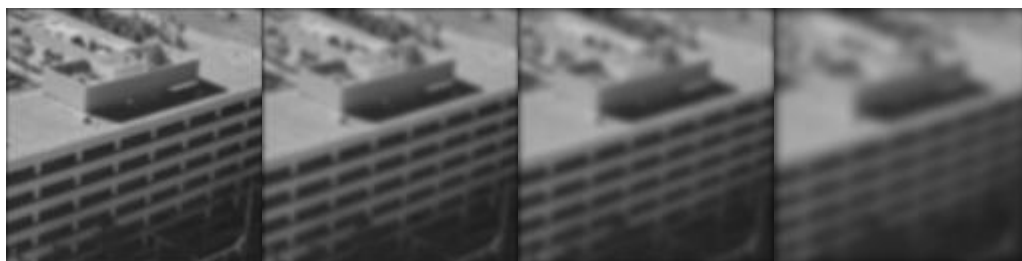
Result

For the first one of five images, 4 values of Sigma (Gaussian filter) and 4 pairs of Hysteresis thresholding values (high, low) will be applied and results will be shown. The goal is to show the difference between vary Sigma and Hysteresis thresholding values.

For the rest 3 images, only one sigma (Gaussian filter) and Hysteresis thresholding result will be shown, but the parameters is well tuned.

Building.pnm

Original



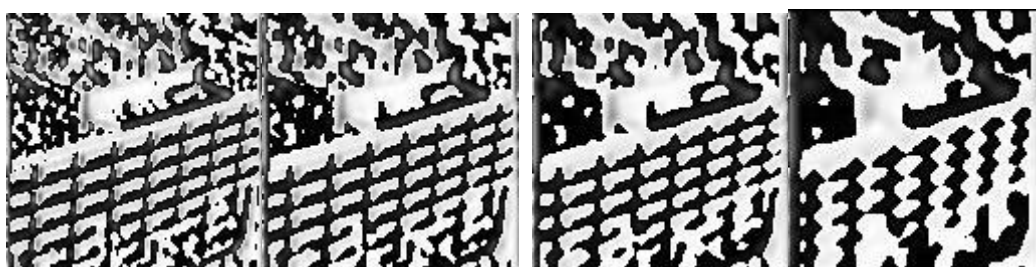
Sigma: 1

1.5

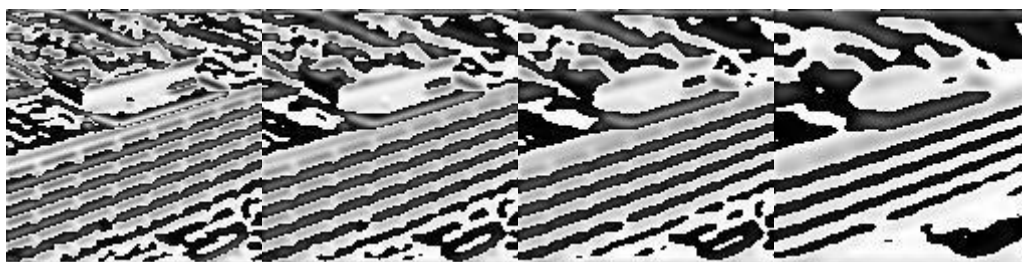
2

3

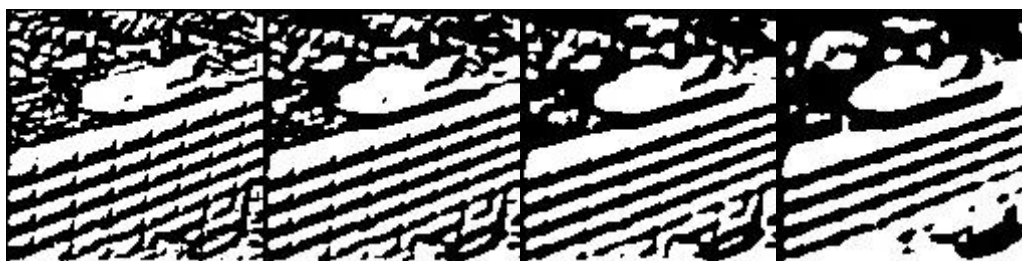
Gaussian filter



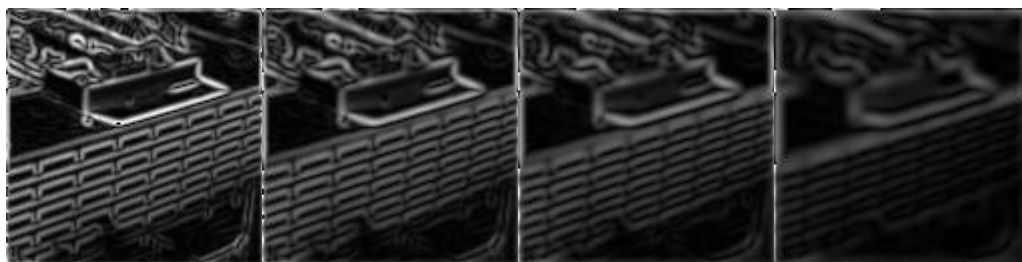
Gradient X



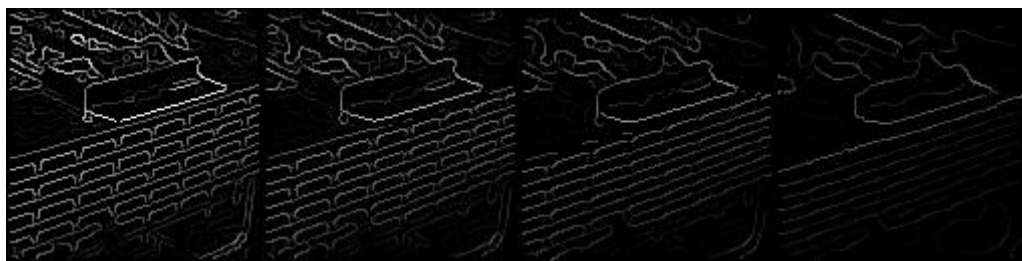
Gradient Y



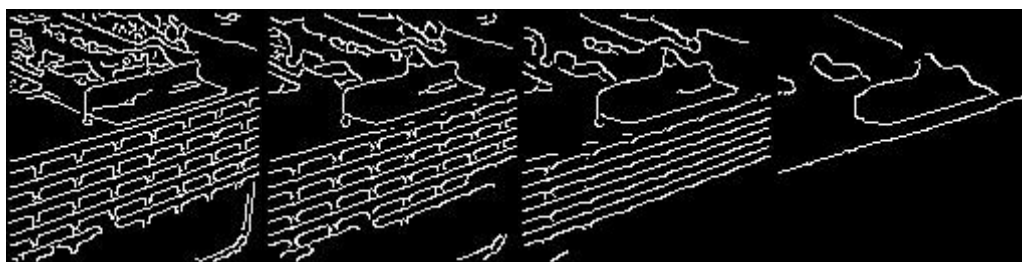
Gradient angle



Gradient magnitude



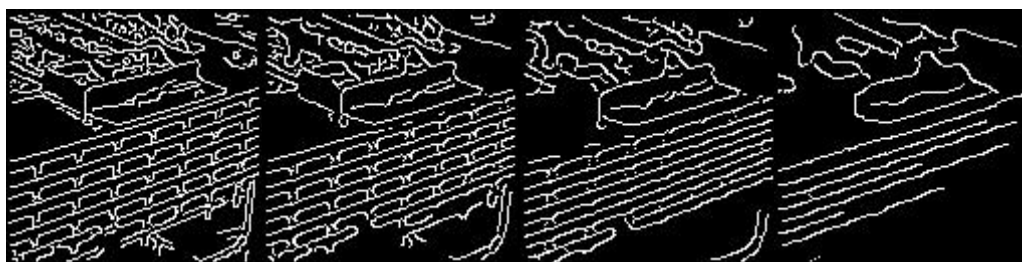
Non-maximum suppression



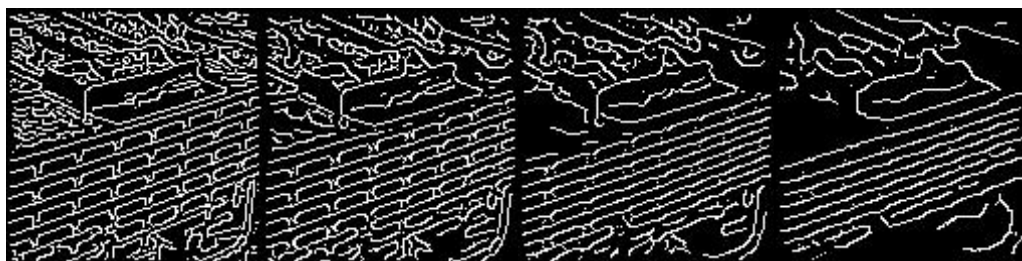
(High,Low):

60, 30

Hysteresis thresholding

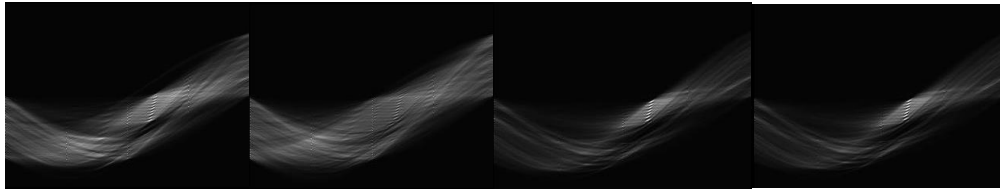


30, 15



10, 5

Building.pnm






Hough transform

hinge.pnm



Original

Gradient X	Gradient angle	Non-maximum suppression
		



Sigma 0.5
Gaussian filter

Gradient Y

Gradient
magnitude

Hysteresis
thresholding



Hough Transform

hinges.pnm



Original

Gradient X

Gradient angle

Non-maximum
suppression

Gradient Y

Gradient
magnitude

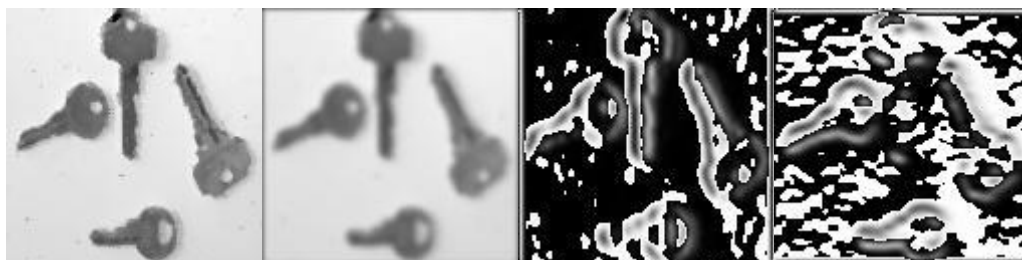
Hysteresis
thresholding
(H, L) = (30, 15)



Hough Transform

keys.pnm

Original

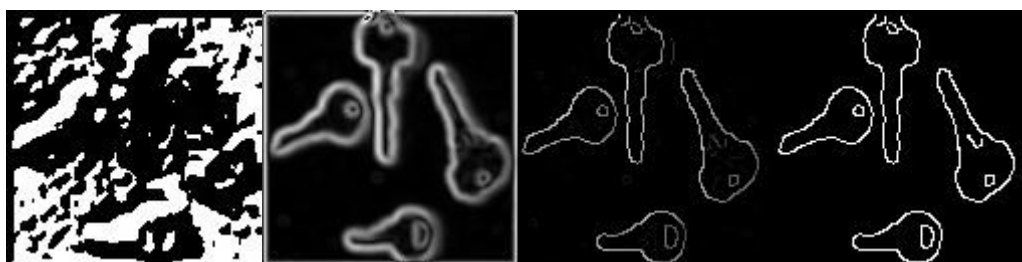


Median filter 3x3

Sigma 1.5
Gaussian filter

Gradient X

Gradient Y

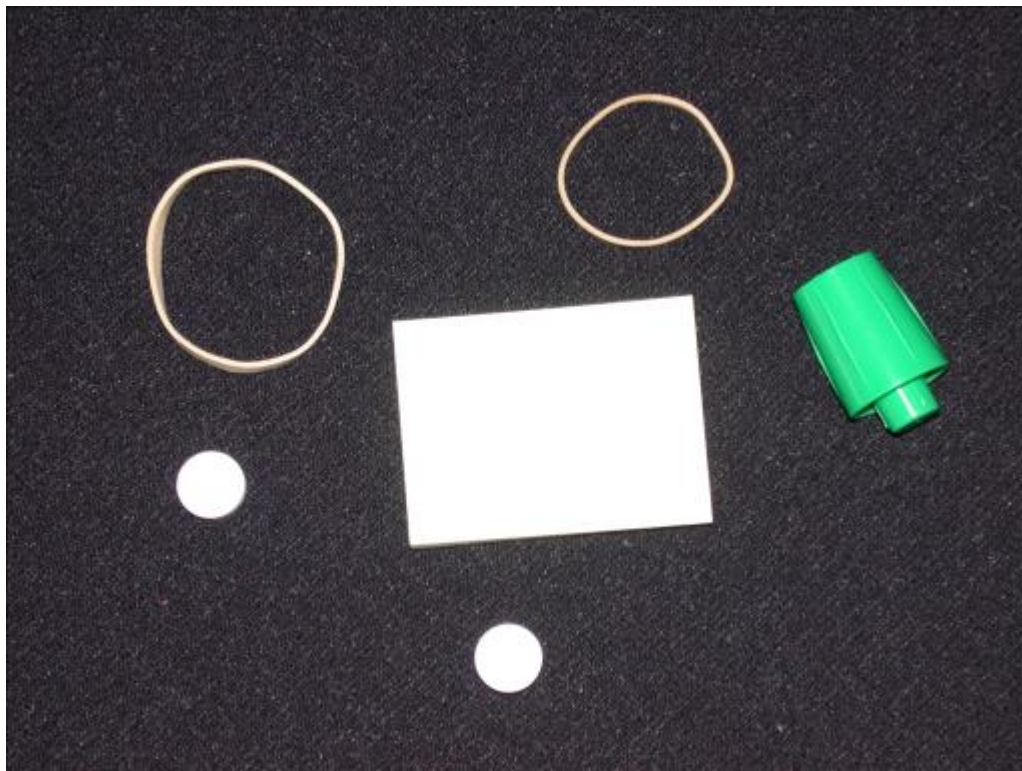


Gradient angle

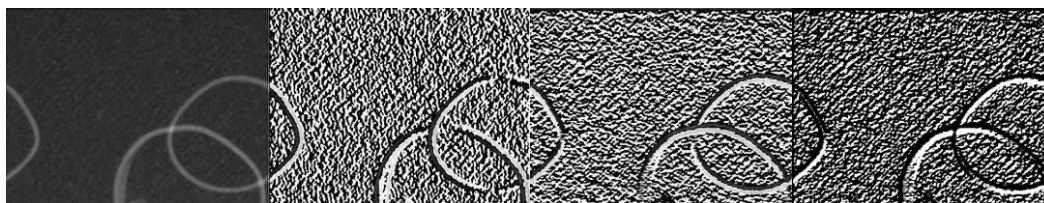
Gradient magnitude

Non-maximum
SuppressionHysteresis
Thresholding
(H, L) = (60, 30)

Hough Transform

pillsetc.pnm

Original

Sigma: 1.5
Gaussian filter

Gradient X

Gradient Y

Gradient angle



Gradient magnitude

Non-maximum
SuppressionHysteresis
Thresholding
(H, L) = (60, 30)

Hough Transform

Conclusion

For the last image, only part of the image is processed. The problem is that I did not implement the RGB conversion when reading the image. Therefore, this RGB image is processed in the same way as other gray scale images. The edge detection still works fine for it.

This project is very interesting and meaningful. The challenge is the difficulty of implementing such complicated algorithms. This project improves my understanding of Canny edge detector and Hough transform algorithms. In addition, it greatly improve my programming skills.