2021 影像處理 Image Processing Homework 1

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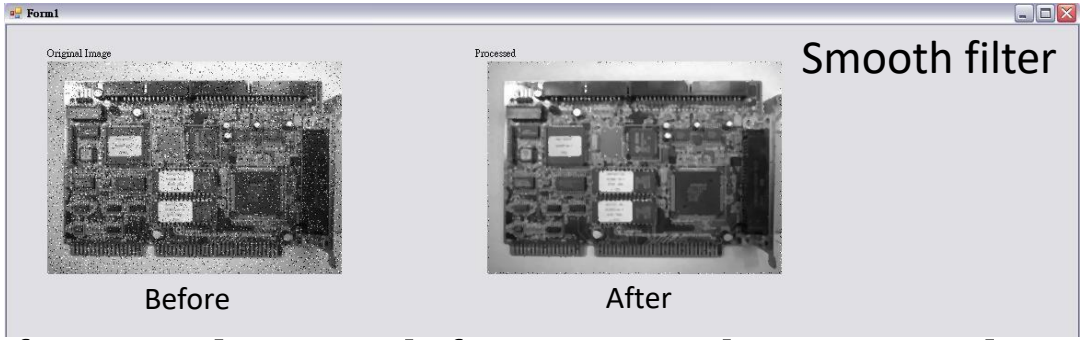
Problem

- 1) RGB Extraction & transformation (10%)
- 2) Smooth filter (mean and median) (10%)
- 3) Histogram Equalization (10%)
- 4) A user-defined thresholding (5%)
- 5) Sobel edge detection (15%)
- 6) Edge overlapping (5%)
- 7) Connected Component (15%)
- 8) Image registration (20%)

※ Program functionality (10%)

Basic requirement

- Using C++ or C# to write the program. You can download visual studio software on the web page of computer and network center of NCKU. (2015 or above version is recommended; if you are not familiar with both C++ and C#, C# is suggested)
- Your program must show the results as **before** and **after** the processing step on the screen simultaneously.



- Program functionality : Each function can be processed **independently, following the previous step, and "undo"**.
  （e.g. Performing sobel edge detection after smooth filter, and then undo)
- Problem (1) deals with the color input images, the others problems handle gray level images.

1. RGB Extraction & Transformation

- Requirement - Extract the R, G, B channel from the color image and transform it to gray scale image.

- Color extraction (6%)
  - Extract R、G、B channel to each image

- Color transformation (4%)
  - Change color image to gray scale image

Source

R channel

G channel

B channel

Grayscale

2. Smooth filter (mean and median)

- Requirement – Implement mean(5%) and median(5%) filter

  ∗Filter size : 3x3

Source

Mean

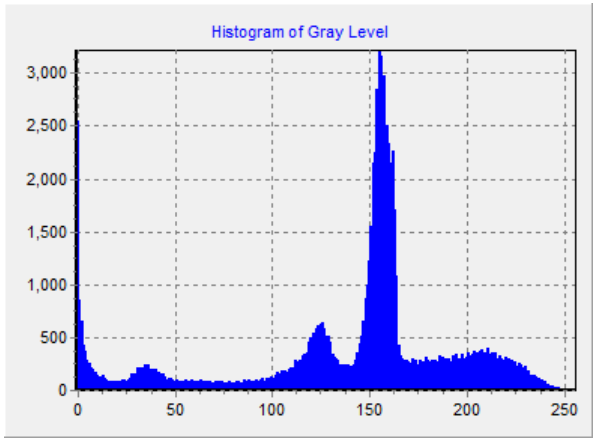
Median

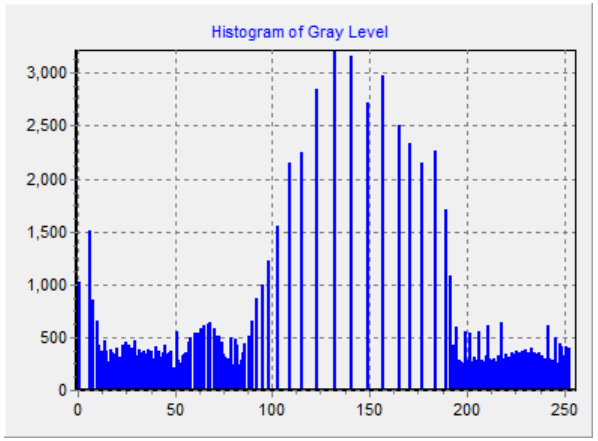
3. Histogram Equalization

- Requirement – Implement histogram equalization (5%)
  need to show histogram of image before and after processing (5%)

Original

Result

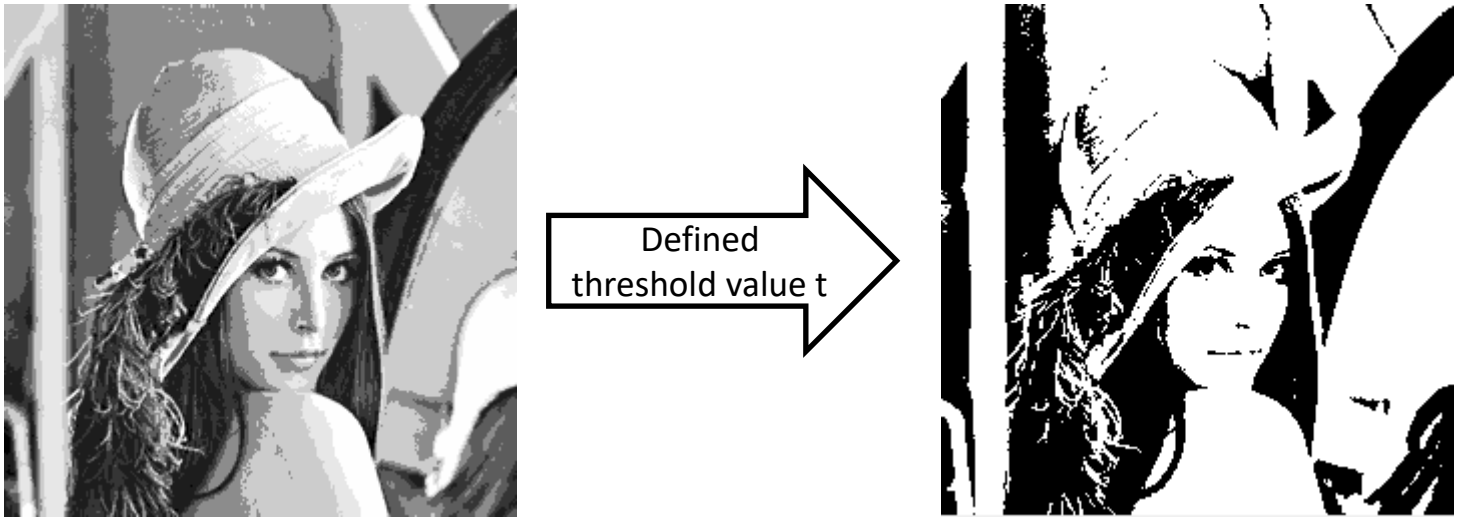




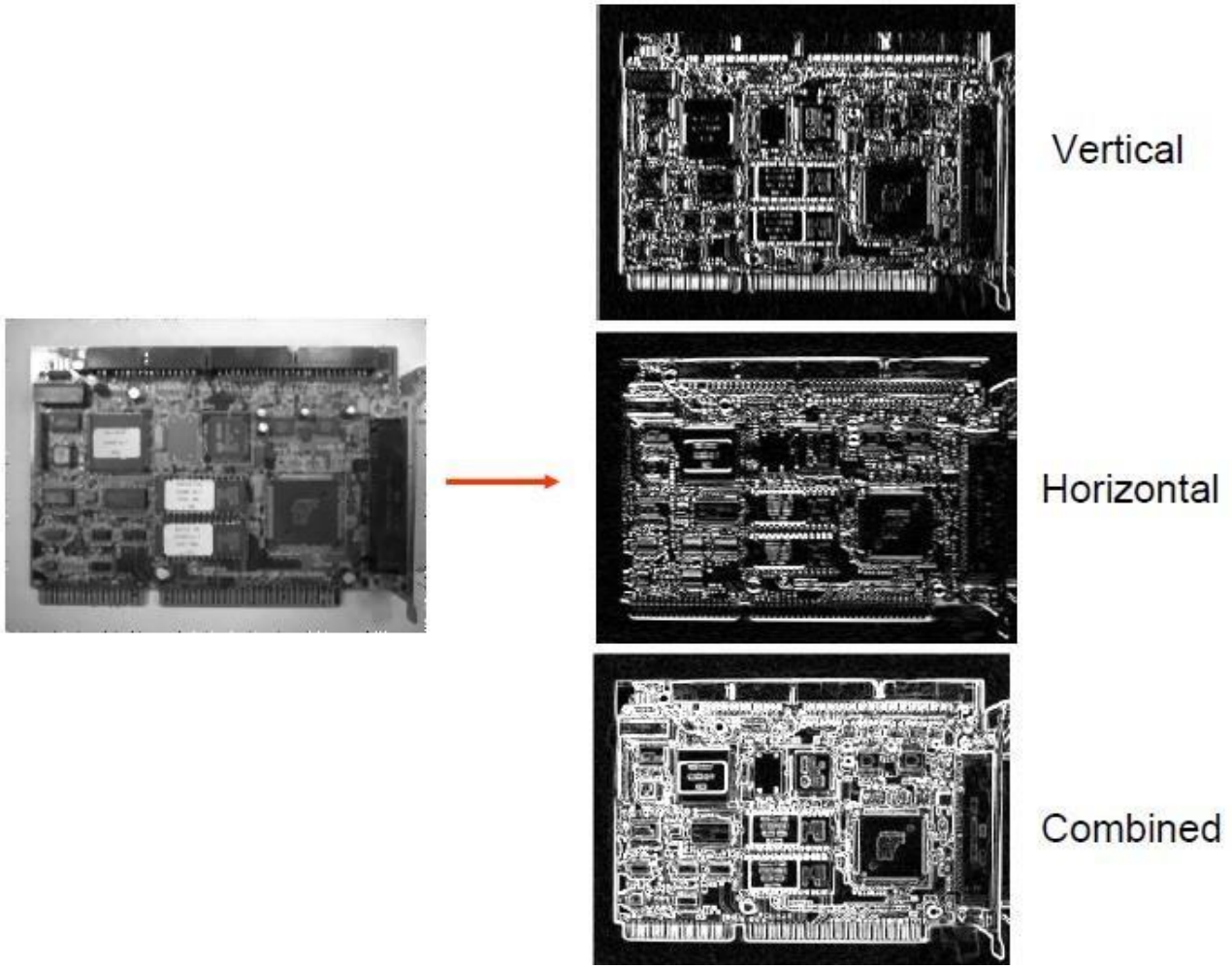
4. A user-defined thresholding

- Requirement – Given a threshold t. The intensity of a pixel which is **higher than** or **equal to** t will be set as white (255), otherwise set as black (0).

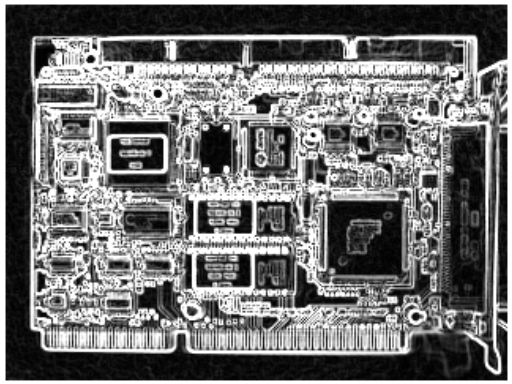
※ The threshold should be input on the interface.



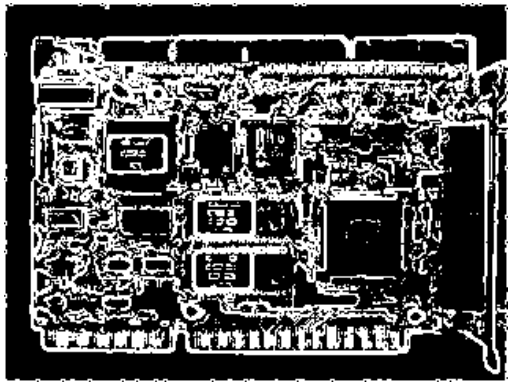
5. Sobel edge detection (vertical, horizontal, and combined)



6 Threshold the result of (5) to binary image and overlap on the original image

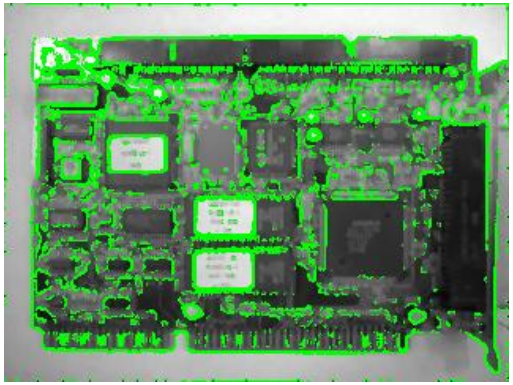


The result of (5)



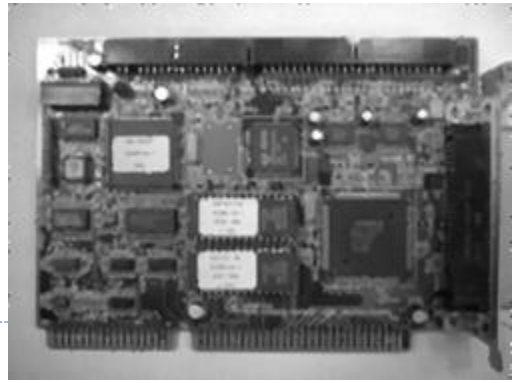
The result after thresholding

(The threshold should be adjusted on the interface)



Overlap on the original image by green color

original image



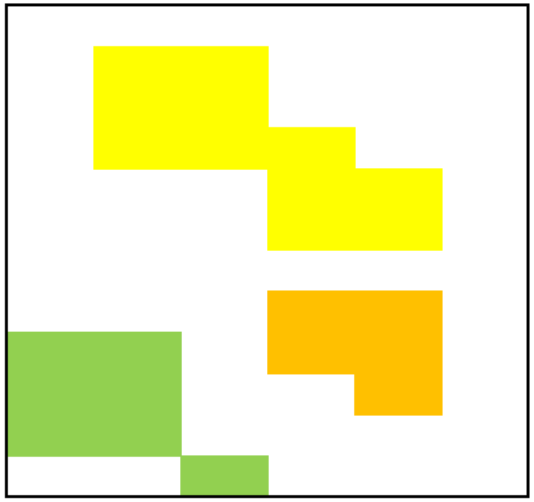
7. Connected Component : Count the number of connected regions in a binary image and paint it with different colors

Input image : Foreground(black), background(white)
Hint : Section 2.5
Using 8-adjacency
The pixel on the border of the image should be considered.
Adjacent region should display in different colors.

255	255	255	255	255	255
255	0	0	255	255	255
255	0	0	255	255	255
255	0	0	0	255	255
255	255	255	0	0	255
255	255	255	0	0	255
255	255	255	255	255	255
255	255	255	0	0	255
0	0	255	0	0	255
0	0	255	255	0	255
0	0	255	255	255	255
255	255	0	255	255	255

Input Image

Num of Connected region : 3



Result

8. Image registration

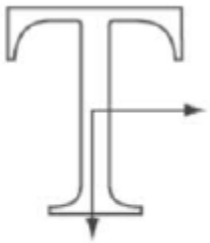
- General form

$$[x \;\; y \;\; 1] = [v \;\; w \;\; 1]\boldsymbol{T} = [v \;\; w \;\; 1]\begin{bmatrix} t_{11} & t_{12} & 0 \\ t_{21} & t_{22} & 0 \\ t_{31} & t_{32} & 1 \end{bmatrix}$$

Scaling

$$\begin{bmatrix} c_x & 0 & 0 \\ 0 & c_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

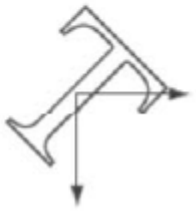
$$x = c_x v$$
$$y = c_y w$$



Rotation

$$\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$x = v\cos\theta - w\sin\theta$$
$$y = v\cos\theta + w\sin\theta$$

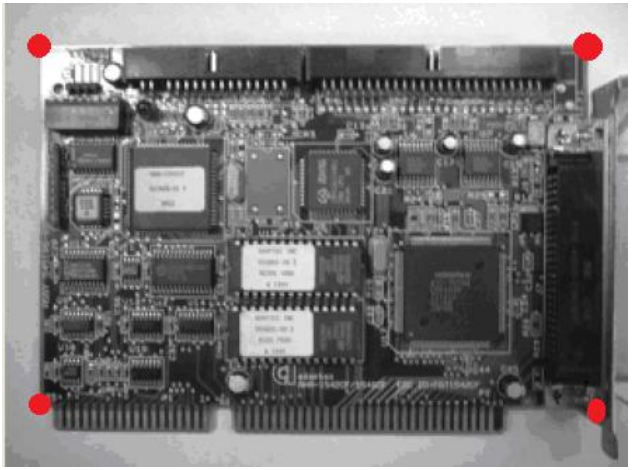


8. Image registration

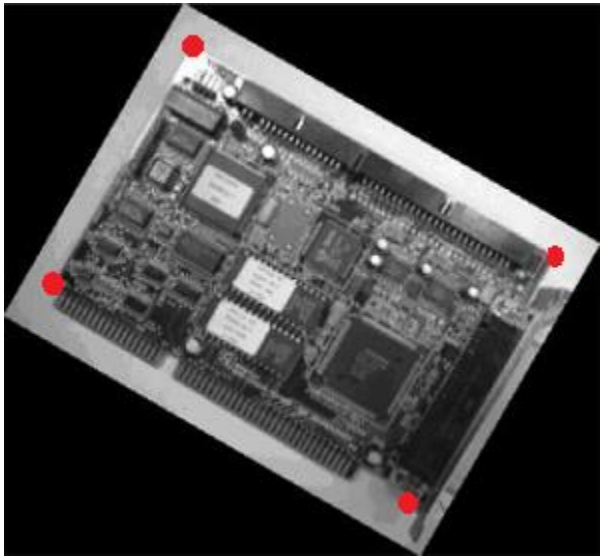
Requirement – Given two images A and B, B is a transformation of A by scaling and rotation.

Please register image B to image A.

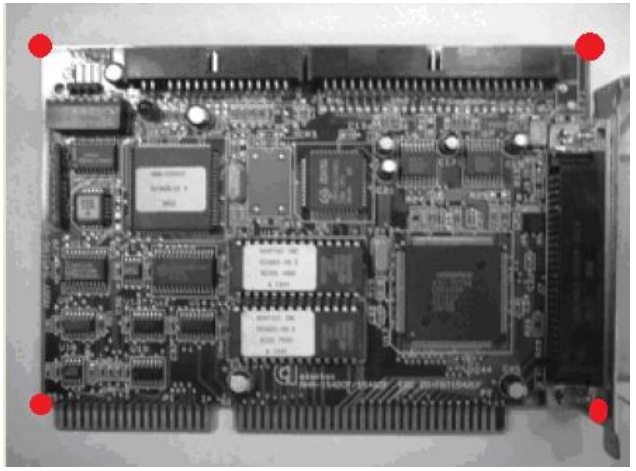
A



B



Registered



8. Image registration

Find

(1) the scaling factor s of the registration and

(2) the rotation angle θ(clockwise) and

(3) Evaluate the difference between image A and registered image

Intensity difference

$$D_{pixel} = \frac{1}{|I|}\sum_{p\in I} |\widehat{i_p} - i_p|,$$

$$I: points\ in\ image, i_p: intensity\ of\ point\ p$$

Notice

- The report should be written in Chinese or English, and **4 pages in length at least**. The report should include the **problems**, **methods**, **results**, **discussion** and **conclusion**. Please print it out and hand in at the demonstration.
- The demonstration will be held in Room 65702 during **11/11(Thur)**. The schedule will be announced in advance on NCKU moodle.
- Please inform the teaching assistant if you cannot attend the demonstration one week earlier.

- **Image processing related library cannot be used and it is not allowed to copy homework.**

File Upload

- Please compress the program source code, execution file(release mode) and report as a zip file and **upload** it to FTP **before 11:59 p.m. of 11/06(Sun)**.
  - ftp://140.116.247.97, port:102
  - id: imagehw
  - password: imagehw
- The format of the zip file name :
  - [VS version]_[student id].zip
    - e.g VS2019_P78901234.zip.
  - Please add your version number if you have any new update
    - e.g. VS2019_P78901234_v02.zip

Vision System Lab (Room 65702)

Information

- NCKU moodle

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