

# 2020 影像處理 Image Processing Homework 1

Instructor: Dist Prof Sun, Yung-Nien

# Problem

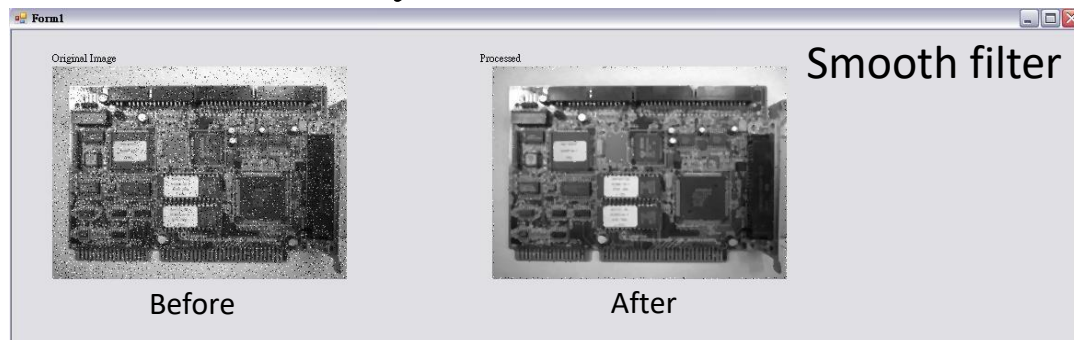
---

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

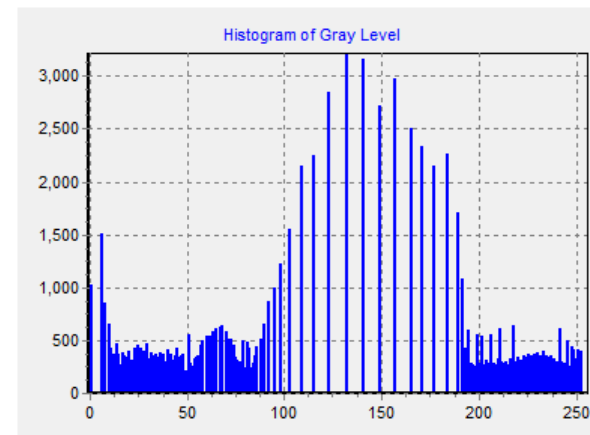
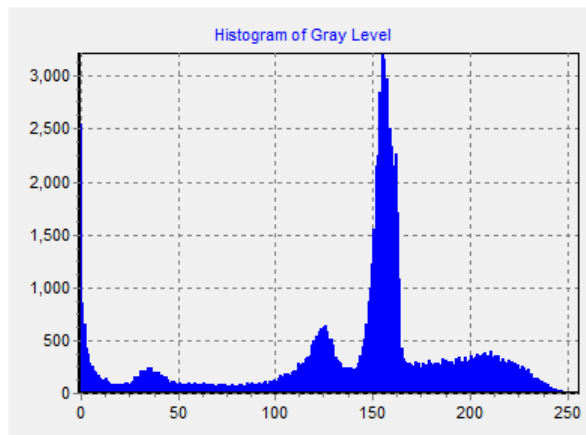
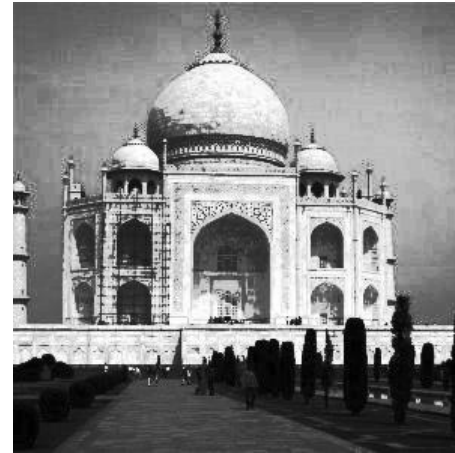
# 3. Histogram Equalization

- ▶ Requirement – Implement histogram equalization (15%)  
need to show histogram of image before and after processing (5%)

Original



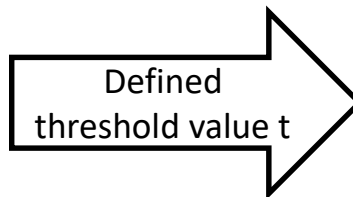
Result



## 4. A user-defined thresholding

---

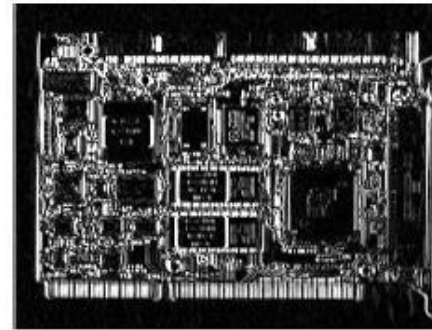
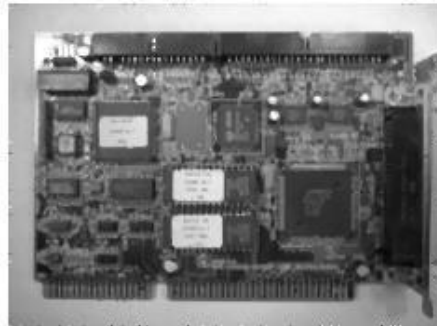
- ▶ Requirement – Given a threshold  $t$ . The intensity of a pixel which is **higher than** or **equal to**  $t$  will be set as white (255), otherwise set as black (0).
- ※ The threshold should be input on the interface.



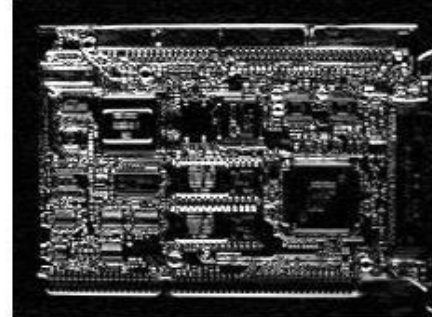


## 5. Sobel edge detection (vertical, horizontal, and combined)

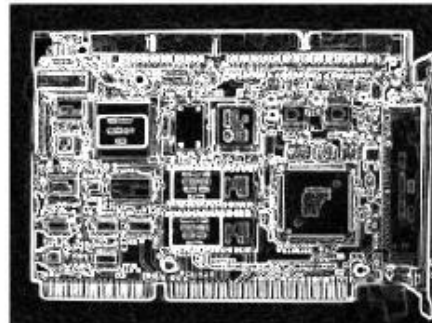
---



Vertical



Horizontal

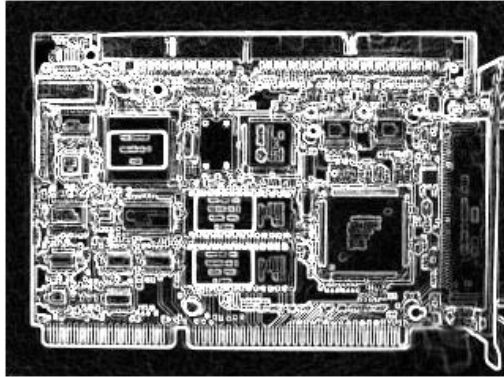


Combined

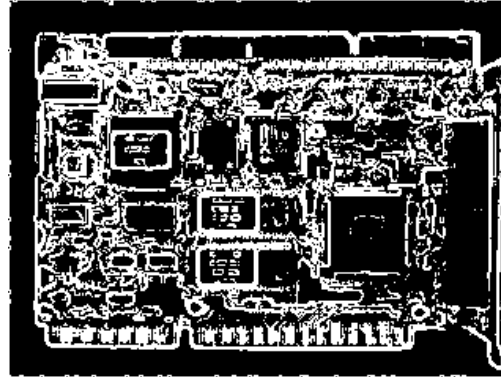


## 6 Threshold the result of (5) to binary image and overlap on the original image

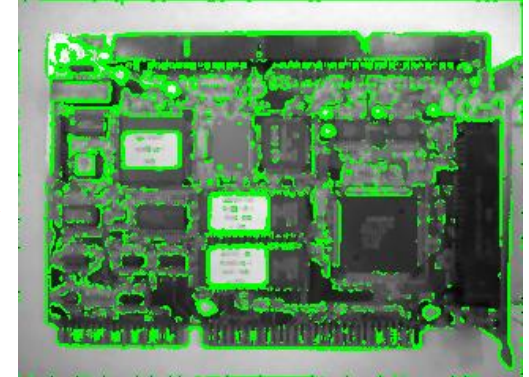
---



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. Image registration

---

- General form

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

Scaling

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

$$x = c_x v$$

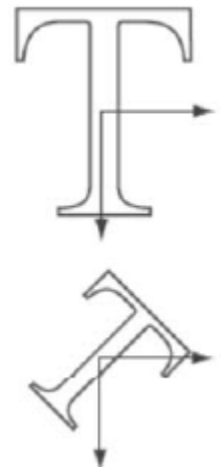
$$y = c_y w$$

Rotation

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

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

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



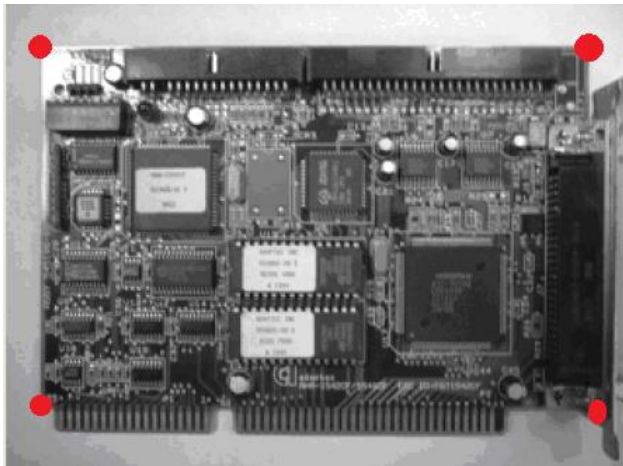
# 7. Image registration

---

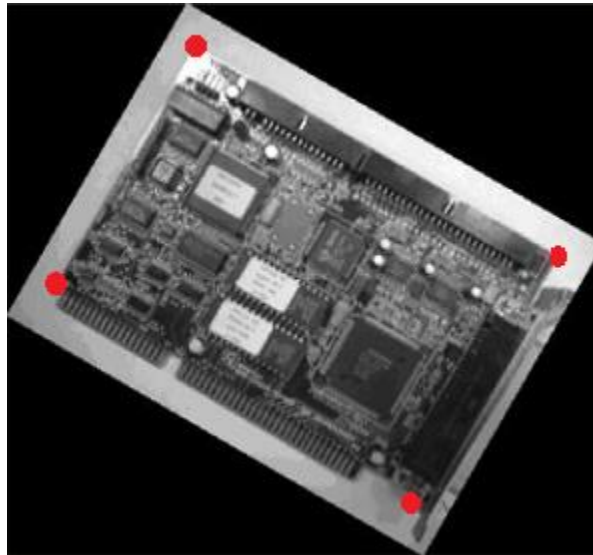
Requirement – Given two images A and B, B is a transformation of A by scaling and rotation.

Please register image B to image A.

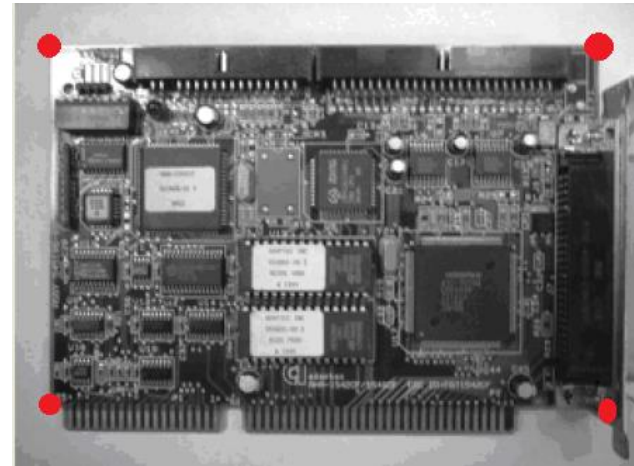
A



B



Registered



## 7. Image registration

---

Find

- (1) the scaling factor  $s$  of the registration and
- (2) the rotation angle  $\theta$ (clockwise) and
- (3) Evaluate the difference between image A and registered image

Intensity difference

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

$I$ : 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 **11/19(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.**

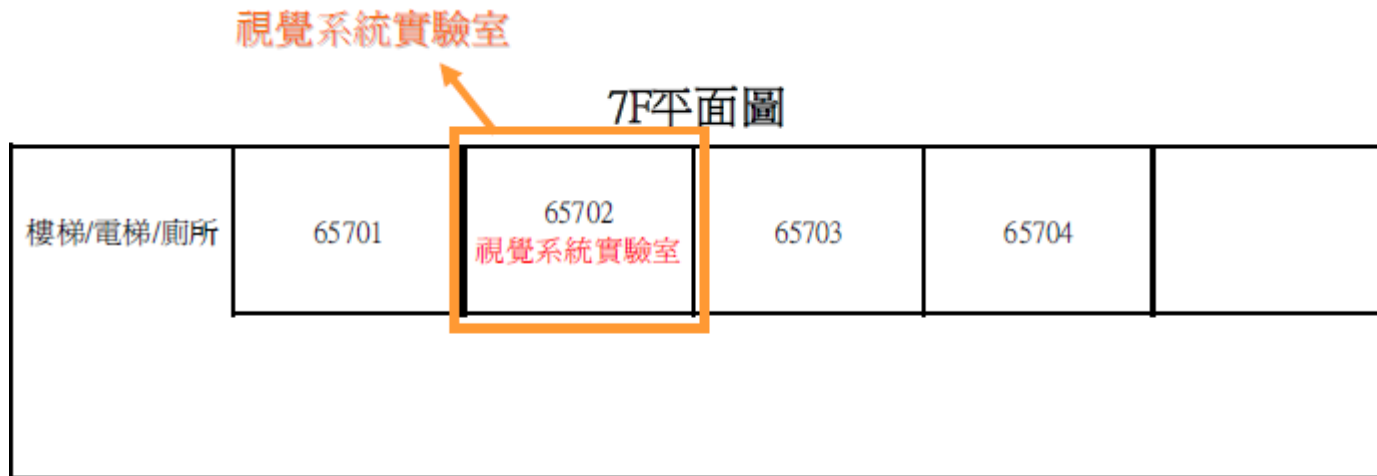
# File Upload

---

- ▶ 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 11/15(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 VS2015\_P78901234.zip.
  - ▶ Please add your version number if you have any new update
    - ▶ e.g. VS2015\_P78901234\_v02.zip

# Vision System Lab (Room 65702)

---





# Information

---

- ▶ NCKU moodle

TA :

[hunghsiang617@gmail.com](mailto:hunghsiang617@gmail.com)

kcl852967@gmail.com