Introduction:

In Physics learning, we need to deal with graphs obtained from various experiments. For different experiments, multitype data should be collected from the images with different resolution and different color scale. Recently, especially in the Big-Data age, it is impossible for researchers to observe patterns via microscope or telescope and figure out all information from images. Then we need computers assisting attaining and processing the image to extract the meaningful information.

With specific algorithms, programs can smooth image, to reduce the noise in image, and sharpen image, to enhance the detail of image. By detecting the rapid color change, program could sketch the edge of figures. With these edges, researchers could select specific item they need to research and count. [1]

During this experiment session, firstly, with TA's instruction, we used a CCD digital camara to capture the view of 1951 USAF resolution test chart and used the offered function to calculate the resolution power of the camara. [2]

Secondly, we used both color image and gray image to test whether the filters composed by us were functional. Then we found that many aspects will influence the final results of the processed images that the selection of kernels and methods of convolution.

Results:

The result images and the original image are contained together in the achieve. [3]

The calculated resolution power of the digital camara: [4]

Photo No.	Distance(inch)	Group	Element	Resolution(second)
1	32.2834	0	4	178.41
2	22.8346	1	1	177.82
3	22.2441	1	1	182.54

Average Resolution = 179.59"

Standard deviation = 2.10

Possible error source:

- System error:
    - The CCD sensor did not work in an absolutely dust-free environment.
    - The subtle inaccuracy of the lenses group caused losing of focus.
    - When TA sent us photos via email, the images were compressed.
- Computational error:
    - When viewing the picture and selecting the elements, we did not use a clear standard.
    - When computing, we only kept 2 digits of float values.

Discussion[5]:

- Spatial frequency is used describe the noise in this lab. Different noise can be removed with correspond filter.
- Image enhancement can help to enhance details, sketch the edge of figures and analyze the source of noise.
- The color difference will cause some color merge and color separation, which will influence the image after lens.
- For counting blood cells, the image had been attached to the post lab notebook.

Conclusion:

In this lab session, we used digital camara to capture images and calculated the camara's resolution power. With such ways, we learned the composition of digital camara and how this device transforms the real light to digital signals.[6] Then we wrote our own code in Python to process images. With different kernels, we used various filters to convolute images and got results.

We discussed our results via zoom meeting, and we found some bugs in our programs. With comparing our results, we fixed them and found that images are stored as unsigned integers array. If we dealt with those integers incorrectly, we might obtain wrong results. After fixing all bugs, we could get similar and correct results.

Reference:

[1] Castleman, K. (1996). Digital image processing. Englewood Cliffs, N.J.: Prentice Hall.

[2] Wikipedia. https://en.wikipedia.org/wiki/1951_USAF_resolution_test_chart

[3] Pixiv.net. Title: 青鳥. Pixiv ID: 8334646. Author: 一葉 smash. https://www.pixiv.net/artworks/83834646

[4] Note1 Ziao.pdf

[5]PostLab Ziao.pdf

[6] How Stuff Works, http://www.howstuffworks.com/

*http://electronics.howstuffworks.com/digital-camera.htm/printable (Appendix 1)