Comp90086 Assignment 1 Report
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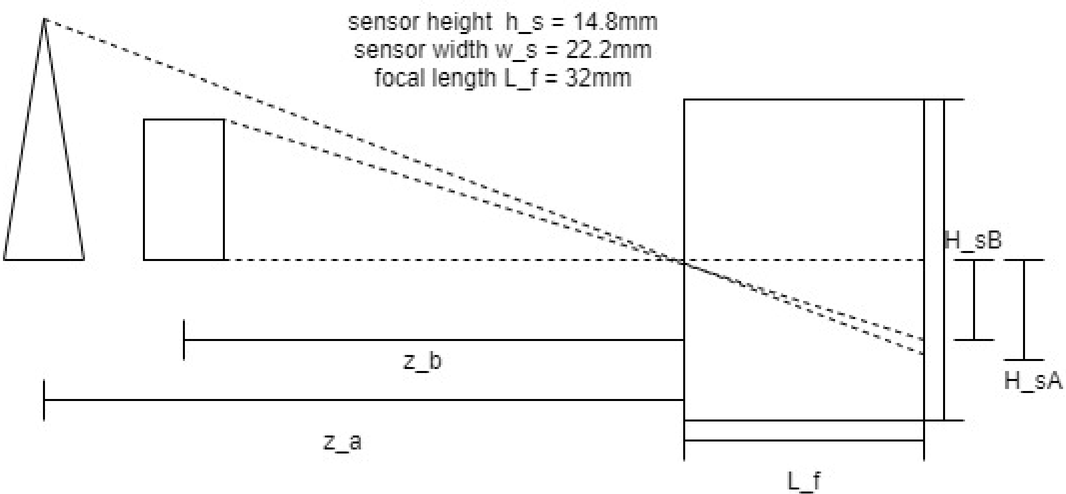
Question 1

Using a software to measure the coordinates of point A and point B on the pixel, I took the coordinates of **point A (750, 122)** and the coordinates of **point B (750, 273)**.
The Height: **H_A： 21.5 cm = 215mm**, **H_B： 9cm = 90mm**
The Height and width of image is (1500, 1000), **H_i = 1500, W_i = 1000**
The sensor has 14.8 mm high and 22.2 mm wide, **H_s = 14.8mm, and W_s = 22.2mm**
(1500, 1000) -> (22.2mm, 14.8mm), therefore, one pixel is 0.0148mm * 0.0148mm, therefore the object height of A and B is 5.5944mm and 3.3596mm on sensor, **H_sA = 5.5944mm, H_sB = 3.3596mm**
We also know focal length is **L_f = 32 mm**
From the picture below we could know, $\frac{L\_f}{H\_sA} = \frac{z\_a}{H\_A}$ and $\frac{L\_f}{H\_sB} = \frac{z\_b}{H\_B}$



for B : 32 mm/ 3.3596mm = z_b / 90mm => z_b = 857.245 mm
for A : 32 mm/ 5.5944mm = z_a / 215mm => z_a = 1229.8 mm
So Point A is (0, 215, 1229.8)

Point B is (0, 90, 857.245)

Question 2

Generally speaking, high-pass filters are used to filter unwanted low frequency signals from a signal, while low-pass filters are used to filter undesired high frequency signals from a signal. High-pass filters allow frequencies above a certain cut-off frequency to pass through, while greatly attenuating lower frequencies, while low-pass filters do the opposite. A band-pass filter is a combination of a high-pass filter and a low-pass filter.

In image pre-processing, a low-pass filter with a Gaussian kernel is used to smooth or blur the image, it attenuates the rapidly changing image values and smoothes out the changes between image values. The parameter radius indicates the radius of the area of the detected image, which determines how large an area of the neighbouring pixels are involved in the filtering operation, such that it implies a threshold value for the frequency allowed to pass through the low-pass filter. As this threshold (and radius of kernel) increases (as shown in figure 1), the low-pass filter allows higher frequencies to pass through and the image is less blurred; as this threshold decreases, the frequency allowed to pass through the image is lower and the smoother the image pixels are directly, the the more blurred the image is.

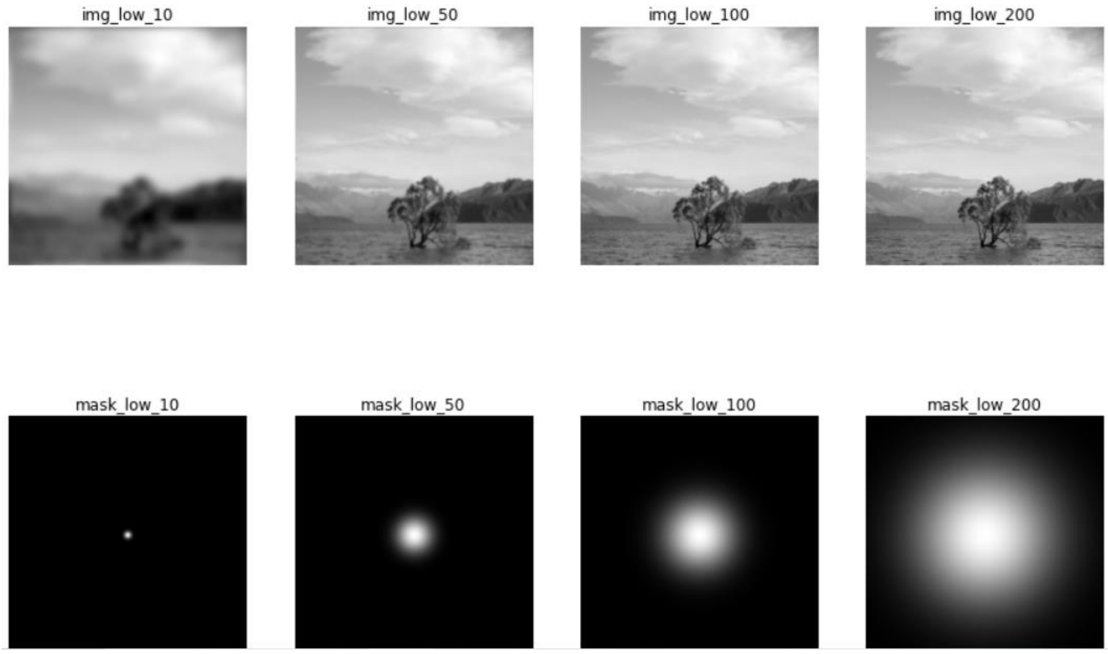


figure 1 low pass filter test

Similarly, a high-pass filter (figure 2) may look like removing blur from an image or sharpening the image, as opposed to a low-pass filter which detects an area of the image and then boosts the brightness of that pixel based on the difference in brightness between the pixel and the surrounding pixels. For images, we generally find that contours are easily recognised because the pixel difference between the two sides of the contour is large and high in frequency, whereas a small difference between the surrounding pixels is low in frequency and will be filtered in a high-pass filter. For the radius of the high-pass filter, a small radius retains more low frequency information, while a radius that is too large will make the message indistinguishable as it filters out much of the low frequency information.

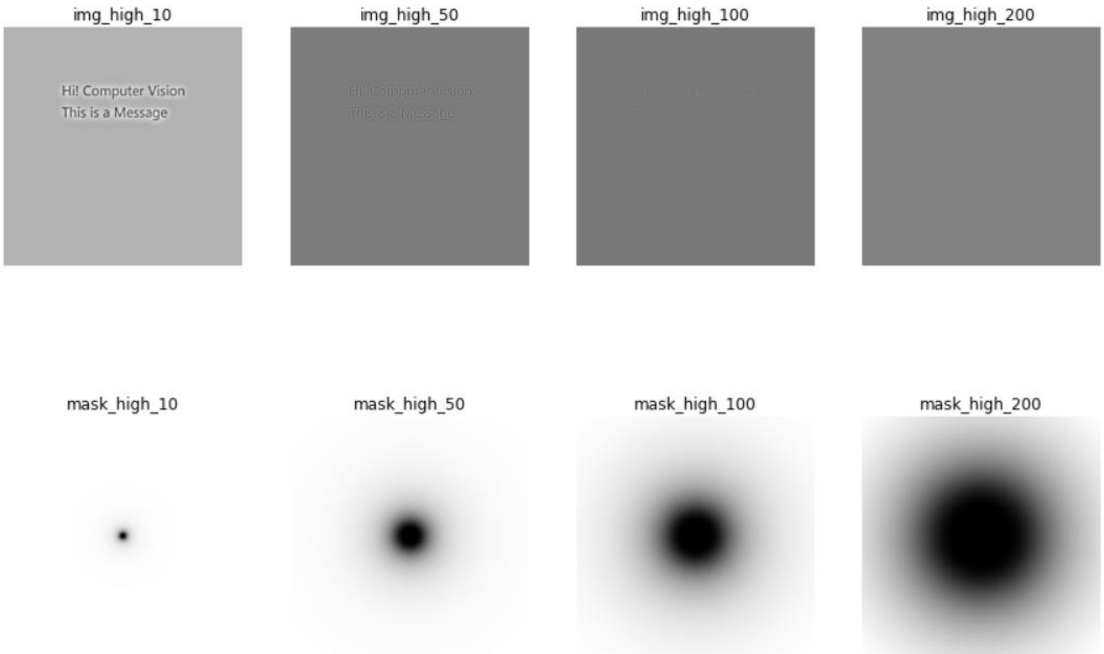


figure 2 high pass filter

The concept of a Gaussian high-pass/low-pass filter is the same as that of an ideal high-pass/low-pass filter, but with a smoother transition than the ideal filter. As in figure 3, In the frequency domain, the Fourier transform shows the high frequency part of an image in the periphery, and the low frequency part in the middle. The principle of a Gaussian high-pass and low-pass filter is to attenuate the frequencies in the middle and the periphery respectively. Therefore high-pass filtered message should retain more information in the periphery and low-pass filtered cover retain more information in the middle.

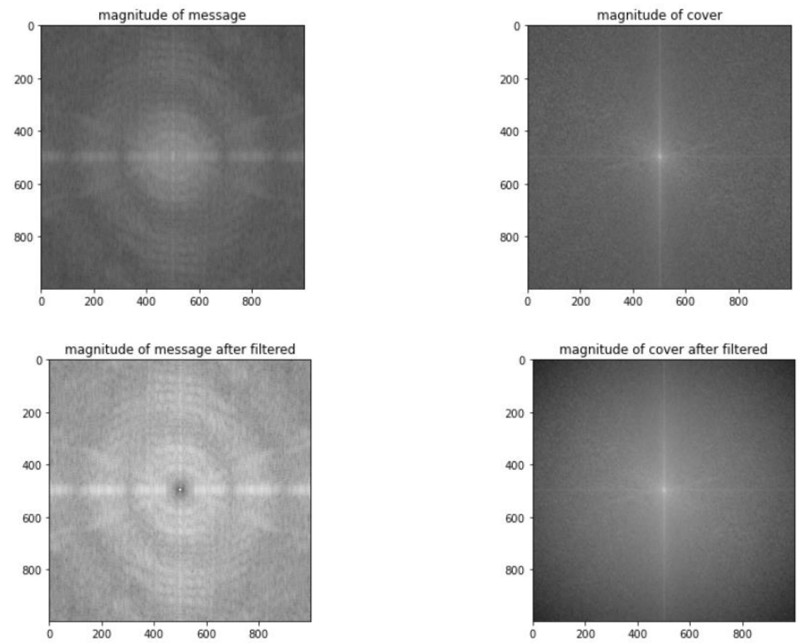


figure 3 magnitude before and after filter

In order to ensure that the message is hidden and the cover is not too blurred, the **radius of the low-pass filter is chosen to be 200** and the **radius of the high-pass filter is chosen**

to be 120, resulting in Figure 4

figure 4 result image