

ECE661HW3

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1 Logic

1.1 Using Point to Point Correspondence

Finding the coordinates of a quadrilateral in image plane and corresponds it with four points in real world. For example, for picture (a), the coordinates of undistorted image should be (100,100), (100,160), (180, 100), (180,100) (biased). The coordinates of points corresponding to these four points in distorted picture is (822, 1140), (762, 1254), (990, 1125), (942, 1245). Thus, we can compute the Homography and apply it. Then the distortion will be eliminated.

1.2 Two Steps Method

Two steps method consists of two steps. First is to eliminate the projective distortion using vanishing line. The second is to eliminate the Affine distortion using dual conic at infinity.

In the first step, two set of parallel lines need to be found. In the second step, two set of perpendicular lines need to be found. Actually, a single quadrilateral can provide these four pairs of lines.

1.3 One step method

One step method depends on five perpendicular lines. Make them satisfy follow equation:

$$l'^T C_{\infty}^* m' = 0 \quad (1)$$

in which

$$C_{\infty}^* = \begin{bmatrix} a & \frac{b}{2} & \frac{d}{2} \\ \frac{b}{2} & c & \frac{e}{2} \\ \frac{d}{2} & \frac{e}{2} & f \end{bmatrix} \quad (2)$$

Setting $f = 1$. Above equation become

$$l'_1 m'_1 a + \left(\frac{l'_2 m'_1 + l'_1 m'_2}{2} \right) b + (l'_2 m'_2) c + \left(\frac{l'_3 m'_1 + l'_1 m'_3}{2} \right) d + \left(\frac{l'_3 m'_2 + l'_2 m'_3}{2} \right) e = -l'_3 m'_3 \quad (3)$$

which is

$$\begin{bmatrix} l'_1 m'_1 & \frac{l'_2 m'_1 + l'_1 m'_2}{2} & l'_2 m'_2 & \frac{l'_3 m'_1 + l'_1 m'_3}{2} & \frac{l'_3 m'_2 + l'_2 m'_3}{2} \end{bmatrix} \begin{pmatrix} a \\ b \\ c \\ d \\ e \end{pmatrix} = -l'_3 m'_3 \quad (4)$$

Do a SVD on C_{∞}^* , H matrix can be retrieved immediately.

In the practical experience, I found that using a square and choose five sets of perpendicular lines in that square can give the most accurate result.c

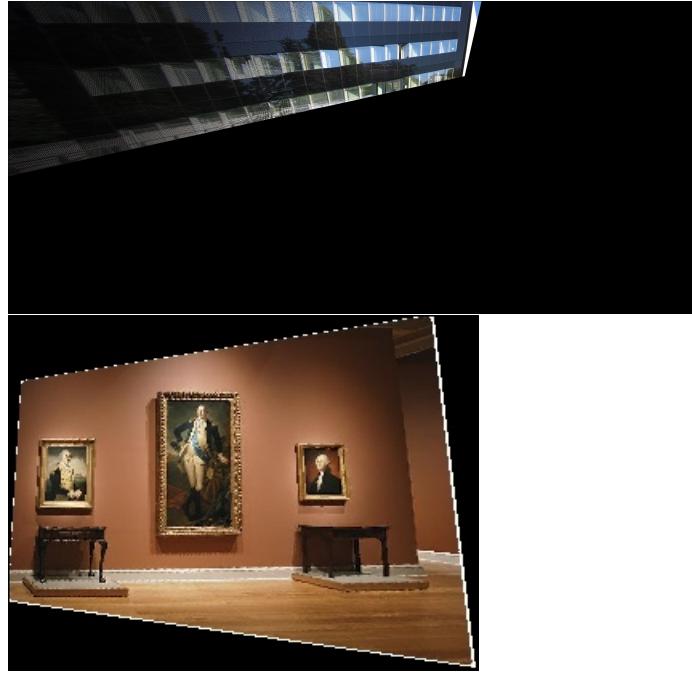
1.4 Conclusion

Although almost all the previous work concluded that two steps method is more robust. In my personal experience, one step method is more robust rather than two steps. By choosing a square in a world plane, and then five perpendicular lines will be generated immediately. And set of lines generated this way can be reliable to remove the distortion. However, two steps often produce unwanted result compared to one step method.

2 Image in problem set

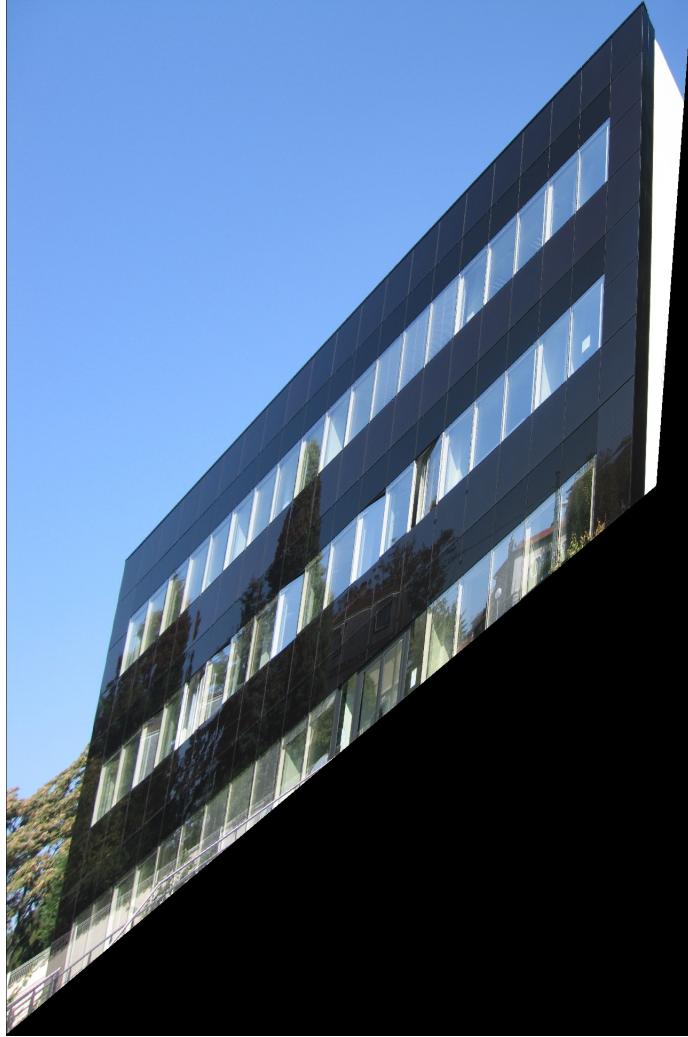
2.1 Point to Point correspondence

First using point to point correspondence to two pictures.

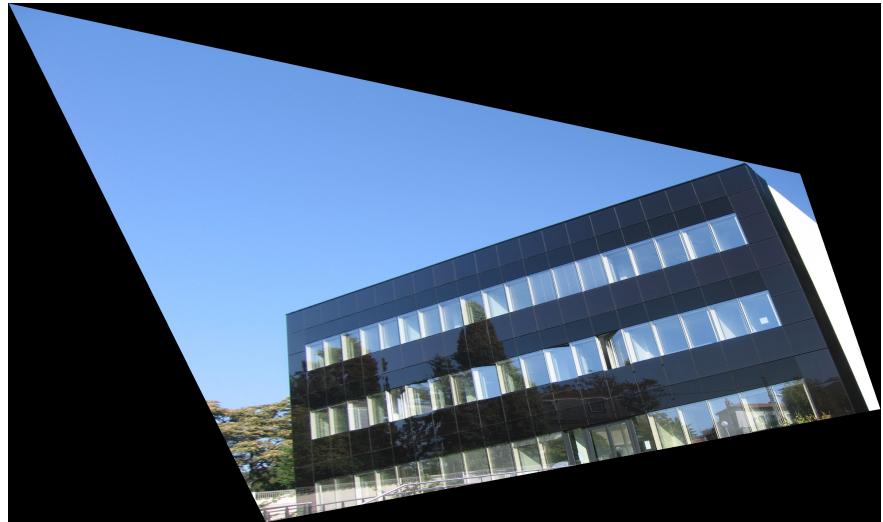


2.2 Two steps Method

After eliminating the Projective distortion, the picture looks like:

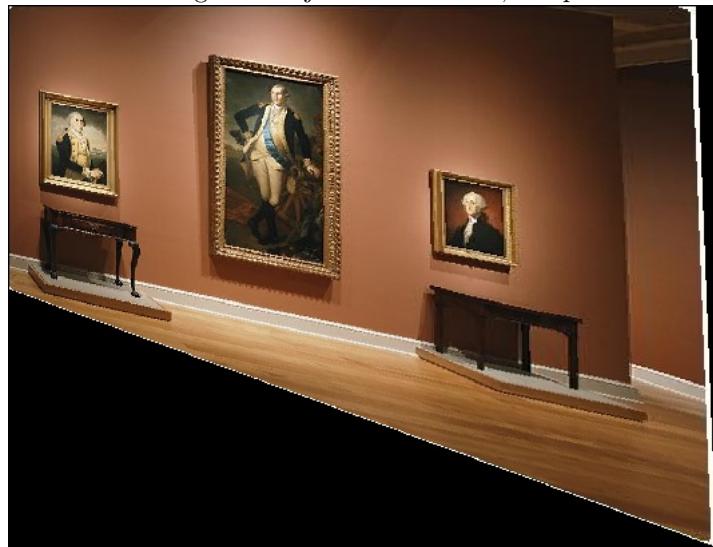


After eliminating the Affine distortion, the picture looks like:



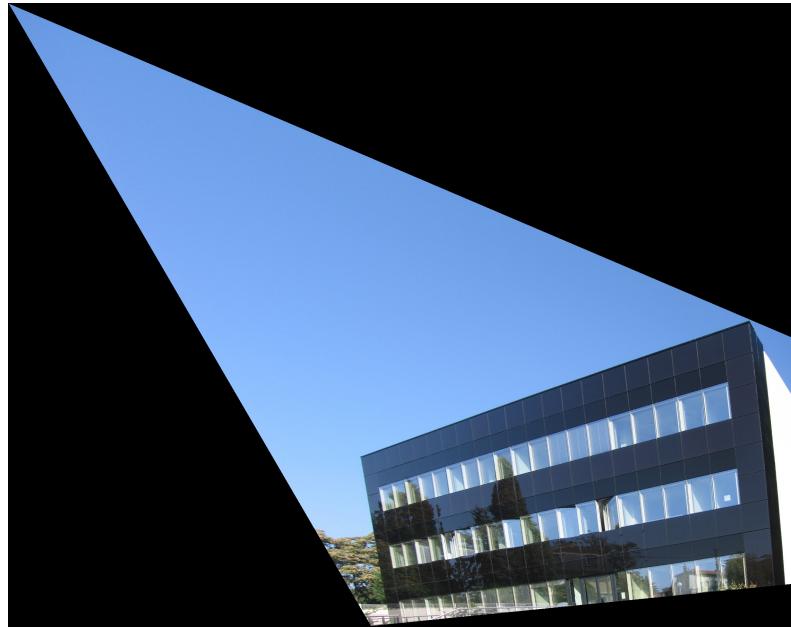
For Second Pics,

After eliminating the Projective distortion, the picture looks like:



3 One step method

For Pic. 1, The result will be:



For Pic. 2, The result will be:





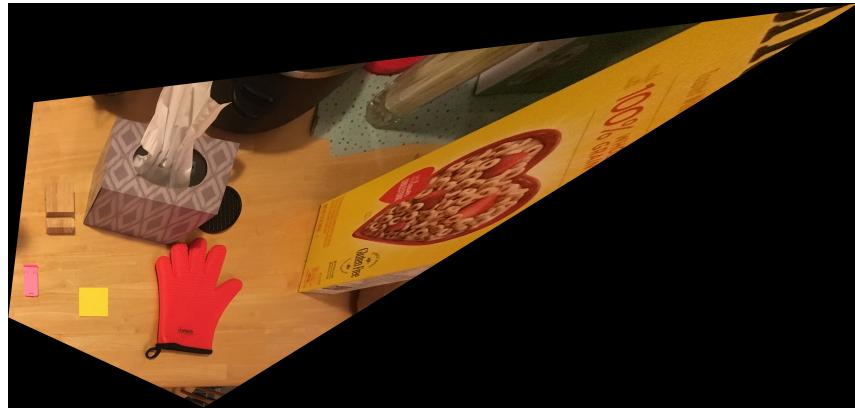
4 My own picture

4.1 my first own picture

Original Picture:



Using Point to Point Correspondence:



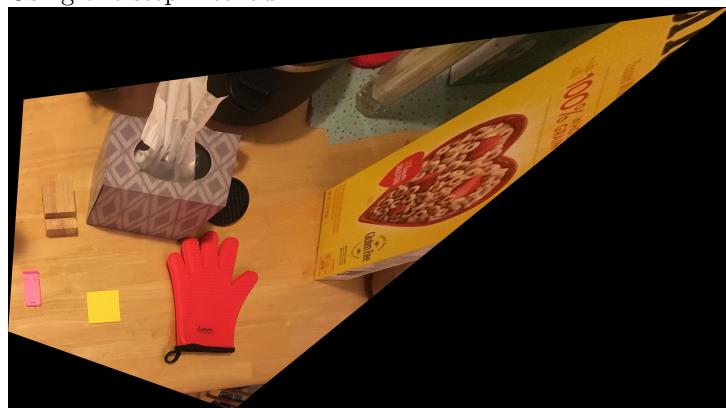
Using two steps method, After removing Projective distortion:



Using two steps method, After removing Affine distortion



Using one step method:

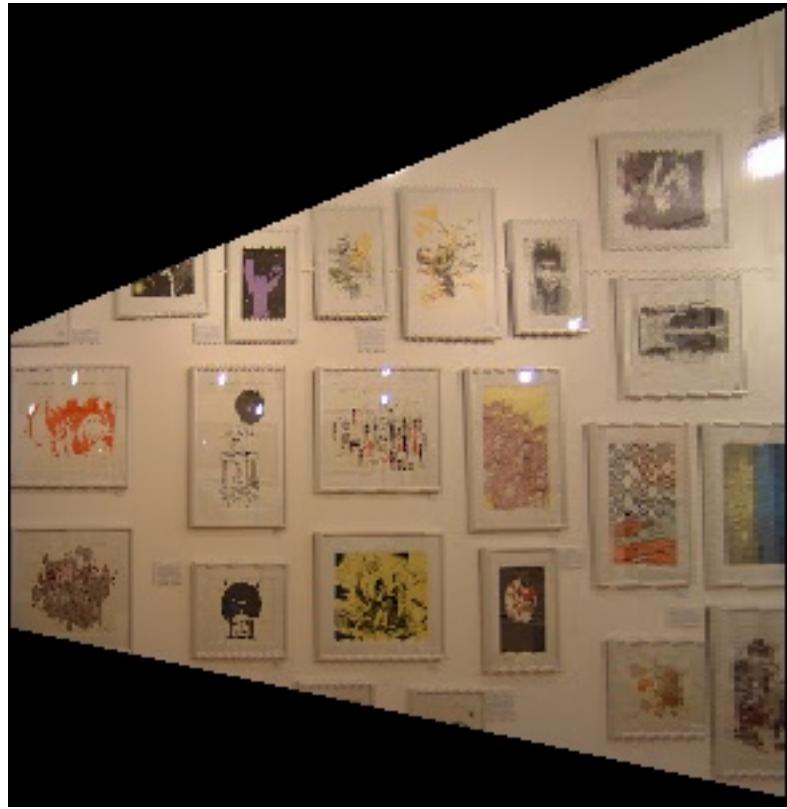


4.2 my second own picture

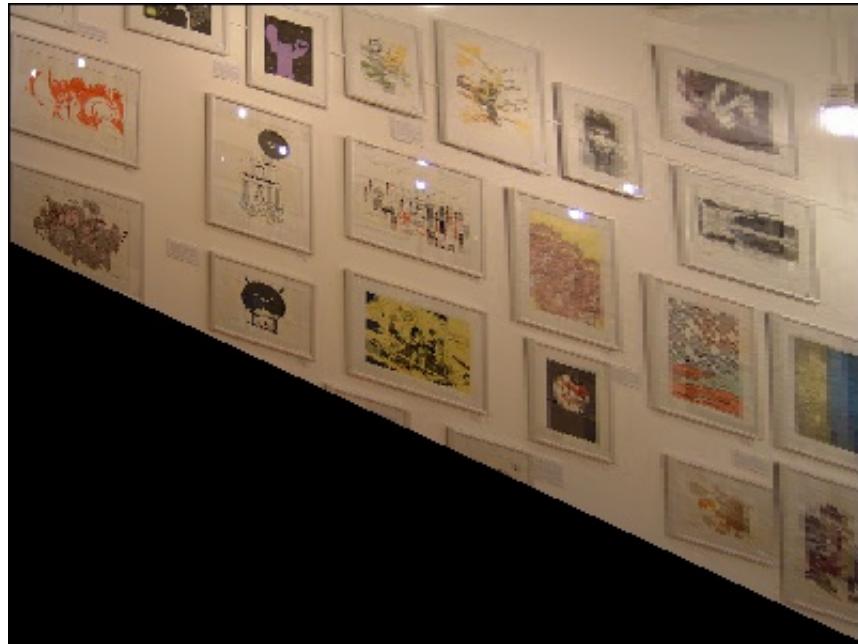
Original Picture:



Using Point to Point Correspondence:



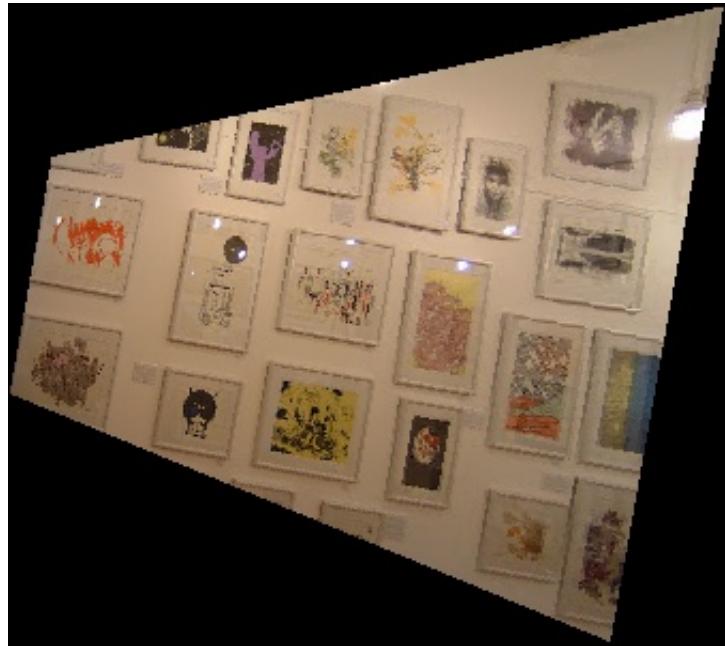
Using two steps method, After removing Projective distortion:



Using two steps method, After removing Affine distortion



Using one step method:



5 Code

Code is attached with this submission.