Computer Vision: from Recognition to Geometry HW3

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Part 1 – Estimating Homography

I tried to implement solution 1 for estimating homography, and the solve_homography(u, v) function is shown below.

```python
1.  def solve_homography(u, v):
2.      N = u.shape[0]
3.      if v.shape[0] is not N:
4.          print('u and v should have the same size')
5.          return None
6.      if N < 4:
7.          print('At least 4 points should be given')
8.
9.      A = np.zeros((2*N, 8))
10.     for i in range(N):
11.         A[2*i, 0:2] = u[i]
12.         A[2*i, 2] = 1
13.         A[2*i, 6] = -(u[i, 0]*v[i, 0])
14.         A[2*i, 7] = -(u[i, 1]*v[i, 0])
15.         A[2*i+1, 3:5] = u[i]
16.         A[2*i+1, 5] = 1
17.         A[2*i+1, 6] = -(u[i, 0]*v[i, 1])
18.         A[2*i+1, 7] = -(u[i, 1]*v[i, 1])
19.
20.     b = np.zeros((2*N, 1))
21.     for i in range(N):
22.         b[2*i] = v[i, 0]
23.         b[2*i+1] = v[i, 1]
24.
25.     h = np.dot(np.linalg.inv(A), b)
26.     H = np.reshape(np.append(h, 1), (3, 3))
27.
28.     return H
```

The images I mapped on the target surfaces are five pictures of the lecturers and TAs in this course. The five pictures and the transformed images are illustrated in **Figure 1** and **Figure 2**, respectively.

| Chien.jpg | Wang.jpg | Tu.jpg | Wu.jpg | Yang.jpg |

Figure 1: Five pictures to be mapped on the target surface

Figure 2: The transformed Times Square image

Part 2 – Unwarp the Screen

The detectable unwarped QR code is displayed in **Figure 3**.

Besides, the link decoded from the QR code is: http://media.ee.ntu.edu.tw/courses/cv/18F/.

Figure 3: The unwarped QR code

Part 3 – Unwarp the 3D Illusion

The top view image of the sidewalk is shown in **Figure 4**, and I did not get the parallel bars from the top view.

For the bars away from the middle, they seem to be a little bit non-parallel comparing to the middle ones, and the reason might come from the camera distortion. If the front image was shot by a camera without camera calibration, the camera distortion may occur. And we cannot project this image to another viewpoint with accurate position.

The solution is to perform camera calibration while taking the front view picture, and use the distortion parameters to calibrate the image in advance. Then, we can follow the steps in this part to mitigate the distortion problem.
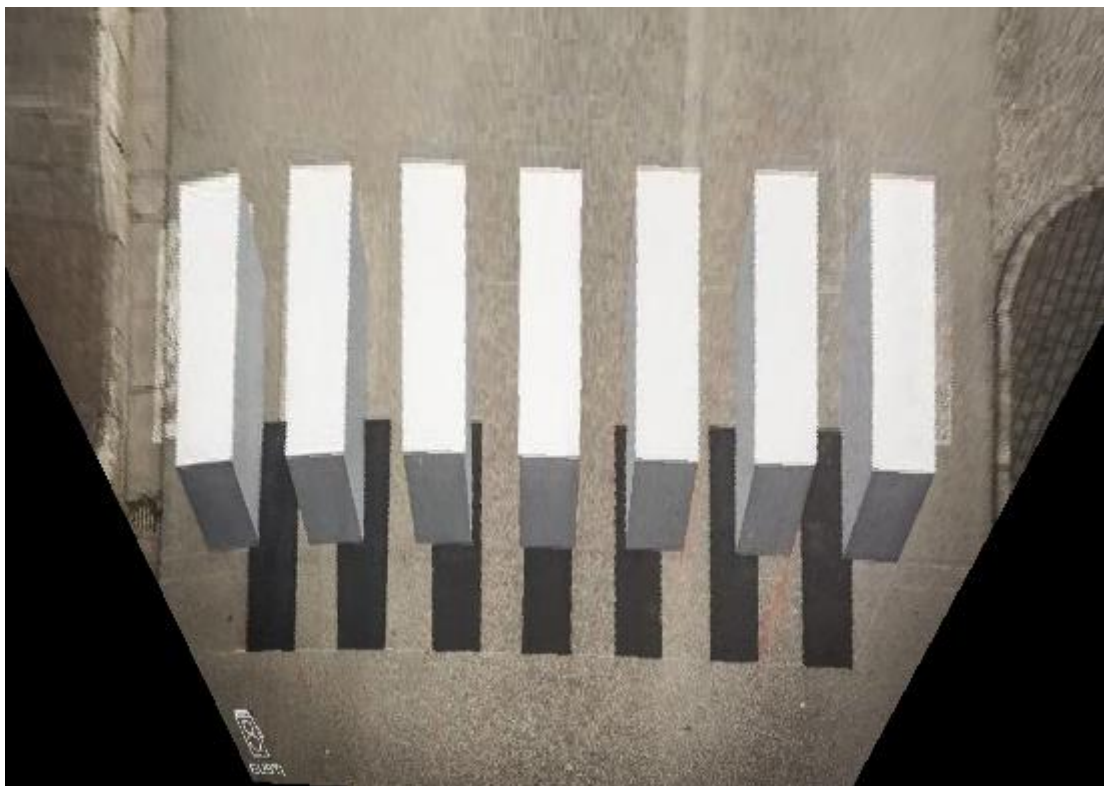

Figure 4: The unwarped sidewalk image